ASD-TDR-61-529

# DETERMINATION OF THE EFFECTS OF ELEVATED TEMPERATURE MATERIALS PROPERTIES OF SEVERAL HIGH TEMPERATURE ALLOYS

TECHNICAL DOCUMENTARY REPORT No. ASD-TDR-61-529

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DIRECTORATE OF MATERIALS AND PROCESSES
AERONAUTICAL SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

45 YEARS OF MATERIALS PROGRESS
SAPPHIRE ANNIVERSARY

Project No. 7381, Task No. 738103

(Prepared under Contract No. AF 33(616)-7056
by Southwest Research Institute, San Antonio, Texas;
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# FOREWORD

This report was prepared by Southwest Research Institute under USAF Contract No. AF 33(616)-7056. This contract was initiated under Project No. 7381, "Materials Application," Task No. 738103, "Data Collection and Correlation," and administered under the direction of the Directorate of Materials and Processes, Deputy Commander/Technology, Aeronautical Systems Division, with Mr. A. W. Brisbane acting as project engineer.

This report covers work conducted from March 1960 to October 1961.

We would like to acknowledge the assistance of the following who contributed to the success of this project: Miss [illegible] Jean Pape, who helped with the data analysis; Messrs. [illegible] L. Edwards and Robert L. Tuck for their [illegible] taking efforts in the laboratory, and Mr. [illegible]ane Rivera for his drafting assistance.

## ABSTRACT

This investigation was conducted to determine mechanical properties of several high performance alloys at room and elevated temperatures. The effects of temperature (up to 1900°F) and exposure (up to 1000 hours) at temperature on the tensile, compressive, bearing and shear properties were determined from measured stress-strain information in both the elastic and plastic range.

The following five materials were considered in the program:

1. 301 extra hard stainless steel
2. Ph15-7Mo (TH 1050)
3. AM 355
4. René 41
5. N-155

All material was from 0.050-inch sheet, except the material for the 1/8-inch diameter shear pins, which were fabricated from 1/4-inch plate. Heat treatment was in accordance with existing specifications for the materials, or other procedures approved by ASD to develop the optimum strength properties.

Descriptions of the test specimens, equipment, and procedures used are included. Test results are reported in tables and in curves showing the effects of temperature and time on the various mechanical properties.

## PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

W. J. Trapp

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Chief, Strength and Dynamics Branch
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| | |
|---|---|
| $D$ | Diameter |
| $E$ | Modulus of elasticity in tension |
| $E_c$ | Modulus of elasticity in compression |
| $e$ | Minimum distance from hole center-line to edge of sheet (in bearing tests) |
| $F_{bru}$ | Ultimate bearing stress |
| $F_{bry}$ | Bearing yield stress |
| $F_{cy}$ | Compressive yield stress |
| $F_{su}$ | Ultimate shear stress - pin shear $= \frac{2P}{\pi D^2}$ |
| $F'_{su}$ | Ultimate shear stress - sheet shear $= \frac{P}{th}$ |
| $F_{tu}$ | Ultimate tensile stress |
| $F_{ty}$ | Tensile yield stress |
| G. L. | Gage length |
| $h$ | Shear path of sheet shear specimen |
| ksi | Kips (1000 pounds) per square inch |
| $P$ | Ultimate load observed on machine |
| psi | Pounds per square inch |
| $t$ | Thickness of specimen |
| $W$ | Half-width of sheet shear specimen |

# I. INTRODUCTION

There has been a pressing need in the aircraft and missile industries for the development of new high temperature alloys to meet the high strength-weight ratios required for the missile and aircraft structural and power plant components. Once these alloys are developed, there is, in general, an immediate need for reliable structural design data, the generation of which can not keep pace with the immediate needs of the aircraft and missile designers who utilize these new alloys. Of particular interest to them are design data for materials to be used for extended periods of time, at extremely elevated temperatures.

The purpose of this investigation was to determine the effects of prior exposure, at test temperature, on the elevated temperature smooth and sharp-notched tensile, compressive, bearing and shear properties of AM 355, N-155, Ph15-7Mo condition Th 1050, AISI 301 (60% cold reduced) stainless steel and Rene' 41.

The materials aforementioned were tested at temperatures up to 1900 F, after exposure at the test temperatures of up to 1000 hours.

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## II. SCOPE OF THE INVESTIGATION

### A. Materials

The five materials evaluated here are standard, commercially available alloys which are being used in the aeronautical industry. Details regarding supplier, heat-treat condition, size, specification, etc., are listed below.

For all five materials listed below, 0.050-inch thick sheet material was tested. Plates of 1/4-inch thickness of these materials were used for the fabrication of the 1/8-inch diameter shear pins, with the exception of the 301 (60% cold reduced) stainless steel. No 1/4-inch plate was available from stock for the 301 stainless steel. Therefore, 0.050-inch sheet was used to determine the shear properties of this material.

#### 1. Sheet Material

N-155 (Multimet)
Supplier: Haynes Stellite Company
Specification: AMS 5532B
Size: 0.050 in. × 36 in. × 96 in.
Heat No. M-5533
Condition: Solution treated by supplier

René 41
Supplier: Haynes Stellite Company
Specification: B-50T59-A-51
Size: 0.050 in. × 37 in. × 65 in.
0.050 in. × 42 in. × 45 in.
Heat No. TV-294
Condition: Annealed by supplier and heat-treated to class C by United Heat Treating Company, Fort Worth, Texas as follows:
Solution treat at 1950°F for 30 minutes, air cool; age at 1400°F for 16 hours, air cool.

AISI 301 (60% Cold Reduced) Stainless Steel
Supplier: Ulbrich Stainless Steels, Inc.
Specification: 60% cold reduced
Size: 0.050 in. × 4 in. × 96 in.
Heat No. 153015
Condition: Cold rolled 60% from 0.125-inch strip by supplier

Ph15-7Mo Condition TH 1050 Stainless Steel
Supplier: Armco Steel Corporation
Specification: AMS 5520A

Size: 0.050 in. X 36 in. X 96 in.
Heat No. 890681
Condition: Annealed by supplier and heat treated to condition TH 1050 by United Heat Treating Co., Fort Worth, Texas as follows:

Heat at 1400°F for 90 minutes, then cool to 60°F within one hour; hold for minimum 30 minutes; subsequently heat at 1050°F for 90 minutes and air cool.

AM 355
Supplier: Allegheny Ludlum Steel Corporation
Specification: AMS 5547A
Size: 0.050 in. X 36 in. X 96 in.
Heat No. 89232
Condition: Annealed by supplier and heat treated to condition SCT 850 by United Heat Treating Co., Fort Worth, Texas as follows:

Heat at 1710°F for 10 minutes, air cool; cool to -100°F and hold for 3 hours; heat at 850°F for 3 hours, air cool.

2. Plate Material

N-155 (Multimet)
Supplier: Haynes Stellite Company
Specification: AMS-5532-B
Size: 1/4 in. X 12 in. X 24 in.
Heat No. M-5506
Condition: Solution treated by supplier

René 41
Supplier: Haynes Stellite Company
Specification: B-50T59-A-S1
Size: 1/4 in. X 12 in. X 24 in.
Heat No. TV-363
Condition: Annealed by supplier and heat treated to class C by United Heat Treating Co., Fort Worth, Texas as follows:

Solution treat at 1950°F for 30 minutes, air cool; age at 1400°F for 16 hours, air cool.

Ph15-7Mo Condition TH 1050
Supplier: Armco Steel Corporation
Specification: AMS-5520A
Size: 1/4 in. X 24 in. X 24 in.
Heat No. 49487-2A

Condition: Annealed by supplier and heat treated to condition TH 1050 by United Heat Treating Co., Fort Worth, Texas as follows:

Heat at 1400°F for 90 minutes, then cool to 60°F within one hour; hold for minimum of 30 minutes; subsequently heat at 1050°F for 90 minutes and air cool.

**AM355**

Supplier: Allegheny Ludlum Steel Corporation
Specification: AMS 5547A
Size: 1/4 in. × 12 in. × 24 in.
Heat No. 69803
Condition: Annealed by supplier and heat treated to condition SCT 850 by United Heat Treating Co., Fort Worth, Texas as follows:

Heat at 1710°F for 10 minutes, air cool; cool to -100°F and hold for 3 hours; heat at 850°F for 3 hours, air cool.

The chemical composition of each material as reported in the suppliers certifications are reported in Table 2. The chemical analyses required by the specifications are also listed.

B Mechanical Properties Determined

The various properties determined from each type of test performed are as follows:

(1) Tensile tests of sheet

a. Ultimate tensile strength
b. Tensile yield strength (0.2% offset)
c Elongation in two-inch gage length
d. Tensile stress at rupture, based on both original and final area
e. Modulus of elasticity in tension
f. Notched tensile strength
g. Notched tensile ratio - ratio of notched tensile strength to smooth tensile strength

(2) Compression tests of sheet

a. Compression yield strength
b. Modulus of elasticity in compression
c. Tangent moduli (compression)

(3) Bearing tests of sheet ($e/D = 2.0$ and $e/D = 1.5$)*

  a. Ultimate bearing strength
  b. Bearing yield strength

(4) Shear tests (pin type for plate materials AM 355, N-155, Ph15-7Mo, and René 41, sheet shear for 301 stainless steel)

  a. Ultimate shear strength

(5) Room temperature and elevated temperature hardness of each material up to 1500°F

(6) Room temperature tensile properties of Ph15-7Mo and AM 355, after exposure at temperatures higher than the tempering temperature

(7) Ultimate tensile strength of the 1/4-inch plate material

C. Test Conditions

The above mechanical properties were obtained at the test temperatures specified in Table 1 for each material, after exposure at these test temperatures for 0.5, 10, 100, and 1000 hours. All tests on Ph15-7Mo, AM 355 and René 41 sheet were performed on specimens cut parallel to the principal direction of rolling, after having previously determined that the properties did not vary significantly with tests performed on specimens cut transverse to the direction of rolling. Tests on AISI 301 (60% cold reduced) stainless steel and N-155 sheet were performed on specimens cut parallel to the principal direction of rolling, as this was the direction that produced the lower ultimate tensile strength.

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*Ratio of edge distance to hole diameter.

## III. SPECIMEN PREPARATION

In order to achieve uniformity of test results, with variations resulting only from materials properties, the various types of specimens were machined to close tolerances. In an effort to eliminate variation in specimen properties which might be caused by fabrication techniques, the same procedures and personnel were used in each phase of fabrication for all materials. Machine shop procedures are described in III-C. Details of specimen fabrication are as follows.

### A Sheet Specimens

The 0.050-inch sheet material received ranged in size from 4 in. X 96 in. to 42 in. X 145 in. On sheets that were 36 in. X 96 in. or larger, oversize specimen blanks were sheared in groups, with each group consisting of one specimen for each type of test as shown in Figure 1. The pattern for shearing a 36 in. X 96 in. sheet is illustrated in Figure 2. The three specimens to be tested for each condition were taken from widely separated groups, in order that the results reflect any materials variation within a sheet. The surfaces of the specimen were left in the as-received condition.

The specimen geometries for the various types of tests were identical for all materials, with the exception of the shear specimens. Because 1/4-inch plate was not available for the 301 extra full hard stainless steel, 1/8-inch diameter pin shear specimens could not be fabricated for this material. A sheet shear specimen (Fig. 6) was substituted for this material.

The specimens fabricated from the 301 stainless steel were sheared from sheets 4 in. X 96 in. The groups of specimens sheared consisted of one specimen for each type of test as shown in Figure 3. The pattern for shearing a 4 in. X 96 in. sheet is illustrated in Figure 4.

1. The tensile specimens were fabricated to conform with QQ-M-151, Type 5, with the ends modified for a pin and clevis type grip (Fig. 6). Groups of six of the oversize blanks were rigidly clamped together for gang-milling of the test section, after the end holes had been drilled. This procedure insured maintaining symmetry with respect to the longitudinal axis through the centers of the pins inserted in the holes.

2. Notched tensile specimens (Fig. 6) were machined to size in groups of six. Care was taken to hold the test section to a 0.500-inch width and the root radius to 0.040 inch within the required tolerances.

3. The 1/4-inch hole in the bearing specimens (Fig. 6) was spaced for the e/D ratios of 1.5 and 2.0. Groups of eight oversize blanks were machined to correct size and the holes drilled. The bearing holes were reamed, individually, to the required tolerances.

4. Compression specimens (Fig. 6) were machined to size in blocks of ten. Great care was exercised in squaring off the ends normal to the longitudinal axis, to maintain specified tolerances.

5. Shear specimens (Fig. 6) for the AISI 301 (60% cold reduced) stainless steel were machined individually being careful to hold the tangency of the slot and circular hole to within ± 0.001 inch.

## B. Plate Specimens

Pin shear specimens of 1/8-inch diameter (Fig. 6) were made from 1/4-inch square blocks cut from the 1/4-inch plate. The specimens were turned to final dimensions on a lathe.

## C. Specimen Fabrication Procedures

### 1. Sheet Specimens

All sheet specimens were first sheared on a Wysong and Miles power shear, leaving 1/16-inch stock on all edges for machining. This amount was found to be sufficient for removal of all material affected by the shearing operation.

The smooth and notched tensile specimens were then machined to size, in groups of fifteen, on a Smith and Mills 27-inch shaper, with a carbide tool bit operated at 8 strokes per minute and 0.010 feed.

The holes in the ends of these specimens, as well as those in the bearing specimens, were drilled individually in a drill jig of a 17-inch drill press. Standard H.S.S. drills were used with a heavy base sulphur oil as the coolant. After drilling, each specimen was reamed with a standard H.S.S. reamer, using the heavy base sulphur oil. The sharp burrs on the face of the specimens were removed with a counter bore with pilot cutter.

The tensile (smooth and notched) specimens were then grouped in lots of six, supported by dowel pins through the reamed holes. A 2-1/2-inch H.S.S. shell end mill was used to form the curved portion of the specimens and the test section. This operation was performed on a No. 16 Van Norman milling machine with a spindle speed of 50 rpm and a table feed of 0.6 inches per minute, using the heavy base sulphur oil as a coolant. The 60° V-notch in the notched tensile specimens was machined, using a formed milling cutter, with a 0.040-inch radius rounded edge. A spindle speed of 50 rpm was used in this operation.

The compression specimens were grouped in lots of six and ground to finish size on a Model 2L Brown and Sharpe surface grinder. The grinder had a spindle speed of 3600 rpm, and the specimens were fed at a rate of 0.040 inch cross feed. Soluble oil was used as a coolant.

The sheet shear specimens were machined in two operations. The 1/16-inch holes were located, marked and drilled on a Bridgeport Universal milling machine. A 14-inch diameter abrasive cut-off wheel was used to grind the 45° slots in the specimens using a spindle speed of 3600 rpm and soluble oil as coolant.

2. Plate Specimens

The 1/8-inch diameter shear pins were fabricated from 1/4-inch thick plate material. Specimen blanks 1/4 in. × 1/4 in. × 2 in. were sawed from the plate stock on a Do-All band saw. The specimens were then turned to size on a Le Blonde 13-inch geared head lathe. A Rex AAA tool bit with a 0 to 2° top rake and 8° front clearance was used for the turning operation with a spindle speed of 750 rpm. A feed of 0.015 inch per revolution was used for finish operations.

See Figure 6 for the geometries and tolerances for the above specimen types.

# IV. TEST EQUIPMENT

## A. Static Tests

### 1. Testing Machine

Static tests were performed in a Baldwin-Tate-Emery 200,000-pound universal testing machine. Periodic calibration of the machine confirmed accuracy of at least 1/4 percent of all ranges. The machine is equipped with a Baldwin Type MA-1 autographic recorder and a strain pacer. To maintain uniformity of results, a strain rate of 0.005 inch/inch/minute was used through yield.

### 2. Extensometers

A model PSH-8MS Baldwin-Lima-Hamilton Dual Extensometer was used to measure the deformation of specimens in all elevated temperature tests.

The instrument is a microformer type strain follower, designed for use in conjunction with the Type MA-1 autographic recorder mentioned above to produce a stress-strain diagram covering the entire deformation range of a tension test specimen. Test results can be recorded at either high (500:1) or low (40:1) ranges of strain magnification. The dual magnification feature permits the test to be recorded at high magnification through the elastic portion and continued to fracture at low magnification. Typical test set-ups are shown in Figures 7 through 14. At room temperature, one of each group of these specimens tested in tension was measured with Tuckerman optical strain gages. Accuracy checks, at room temperature, showed that the microformer repeatedly gave results for the modulus of elasticity within ± 1% of the average of two optical strain gages mounted on opposite sides of the tensile specimens.

### 3. Test Furnace

A split-type three-zone resistance heating Marshall High Temperature Furnace was used in conjunction with the testing machine. The furnace had an inside diameter of 5 inches which accommodated the various types of test fixtures and specimens. With this unit a temperature of 2200°F can be maintained with a temperature distribution of ± 3°F along its length of 16 inches. Very accurate temperature control was achieved by use of a Leeds and Northrup two-action proportional controller-recorder with the thermocouple mounted on or adjacent to the test specimen. Temperature distribution studies on various types of specimens indicated that temperature variations throughout the test section were less than ± 3°F for the entire program. Figure 7 shows the furnace installed in the 200,000-pound BTE testing machine.

4. Aging Furnaces

Exposure of materials to elevated temperatures for the 0.5, 10, 100, and 1000 hour aging times was carried out in four different furnaces. The furnaces used were:

(1) Model OV-18 Blue M Electric Laboratory Oven, with the forced draft feature added. This oven was used for the aging of all materials at temperatures of 400° and 600° F.

(2) Lindberg Type RO-153012-S Electric Rod Box Furnace, with capabilities of operation up to 2100° F. Control of the furnace was achieved by the use of a saturable core reactor in conjunction with a Wheelco model 407 Capacitrol and a magnetic amplifier. This system provides a means of smoothly and steplessly controlling the power to the furnace so that close temperature tolerances (± 5° F) could be achieved at these (1900° F) temperatures.

(3) Lindberg Type 243618 EH Box Cyclone Furnace, with capabilities of operation up to 1200° F.

(4) C. I. Hayes Model LR62 Electric Heat Treating Furnace with capabilities of operation up to 2000° F.

The furnaces were all calibrated with a standard Minneapolis Honeywell Chromel-Alumel thermocouple which was calibrated up to 2000° F at the Honeywell laboratories. Periodic checks were made using as many as nine type K thermocouples to completely define the temperature distribution within the furnaces. By the use of the forced draft features in the lower temperature furnaces and by limiting the volume of the furnace used for aging to approximately 0.5 cubic feet in the higher temperature ovens, it was possible to maintain a temperature distribution at ± 0.5 percent of the desired exposure temperature.

5. Test Apparatus

Unless otherwise noted below, the test fixtures used in this program were identical to those used on Contract AF33(616)-3348, "Determination of Materials Design Criteria for 6Al-4V Titanium Alloy at Room and Elevated Temperatures," and described in detail in WADC Technical Report 53-246, except that they were made of N-155 or Haynes Alloy 25 to withstand the more severe temperature environments encountered in this program.

The compression fixture (Fig. 14) consisted of a Haynes Alloy 25 plunger loaded by attachment to the machine crosshead. The specimen was supported on a Haynes Alloy 25 base with a Haynes LT-1B metal ceramic disc inserted in the top. To prevent buckling in the specimens, side plates with ground, lubricated surfaces were added.

Pin shear tests were conducted in a fixture similar to the one used in our previous program. However, the fixture was modified for our present program to permit use of replaceable hardened inserts as the shearing surfaces. The inserts were fabricated from MV-1 Latrobe tool steel for use at temperatures up to 1000°F, and from Unitemp Waspaloy for use at temperatures from 1000°F to 1900°F. These inserts were replaced after a series of 10 tests to eliminate effects due to wear and insure consistency and repeatability of results.

## B. Hardness Tests

The hardness tests on the materials at room and elevated temperatures were conducted with a Rockwell High Temperature Hardness Tester, Model 6 JR-BB. This tester has a larger throat opening to accommodate the Marshall Furnace used in these elevated temperature hardness determinations. The furnace had capability of operation up to 1500°F, and, used with a 2-action Leeds and Northrup proportional controller recorder, was capable of maintaining a temperature distribution of ± 3°F during the hardness tests.

## V. TEST PROCEDURE

The various tests performed in this program were set up to reproduce the specified conditions as closely as possible. In general, three tests were performed on each material for each condition. Dummy test specimens with several calibrated thermocouples along their gage length were placed in the fixtures before each set of tests. Temperature distribution was checked and the control temperature was varied by changing one or more of the three powerstat settings, until the desired test temperature ± 3°F was attained along the gage length. The controller settings thus determined were used in all subsequent testing at the same temperature. The procedures followed in conducting each type of test are discussed below.

### A. Tensile Tests

The dimensions of each specimen were measured using a micrometer accurate to .0001 inch. The gage length was established on the specimen by means of two scribe marks that were indented into the specimen sufficiently to be visible after testing. A two-inch alloy gage block that was accurate to 0.001 inch was used to establish the distance between the scribe marks. The specimen was then placed in the pin and clevis arrangement for testing, and a small load applied. This initial loading helped to align the fixtures, holders, and specimens within the furnace, so that accurate placement of the extensometer knife edges could be made on the test section. Once the extensometer was attached, the control thermocouple was attached to the specimen and the furnace was shut.

After the specimen had reached the desired test temperature as indicated on the Leeds and Northrup controller-recorder and held for 30 minutes, it was loaded at a strain rate of 0.005 inch/inch/minute through yield, as indicated on the autographically recorded load-deformation curve. The high-low magnification switch on the extensometer switch box was then switched to low and loading was continued to failure at a head travel rate of 0.10 inch/minute.

After the specimen was removed from the grips, the two pieces were fitted together and measured for elongation and final area.

The elongation measurements were made with inside calipers graduated to 0.001 inch, while the width and thickness measurements were made with a micrometer with pointed anvils.

For the room temperature tests, using Tuckerman optical strain gages to measure deformation, the two gages were mounted directly opposite each other on the specimen gage length and held in position by light spring tension. The specimen was loaded by increments to allow accurate reading of the gages with the Tuckerman auto-collimator. When the deformation indicated by the gages showed that the yield stress had been reached, the gages were removed and the specimen loaded at the constant head travel rate to failure.

B. Compression Tests

After specimen dimensions were measured, a one-inch gage length was marked on the center section of the specimen. The specimen was centered on the fixture and supported by lubricated guide plates to prevent lateral buckling. A new high temperature lubricant, X285, manufactured by the Alpha Molykote Company, was used throughout the tests.

After a small compressive load was applied to steady the specimen, the extensometer knife edges were placed on the gage length. After heating to test temperature and holding for 30 minutes, the specimen was loaded at the constant strain rate through yield, as indicated by the curve drawn by the autographic recorder.

C. Bearing Tests

The bearing test consisted of loading the specimen in tension, via two hardened pins, which fitted through the clevises and reamed holes in the specimen. Prior to testing, the hole diameter was measured using a tapered pin marked in increments of 0.0002 inch. The thickness of the specimen was measured using a vernier micrometer graduated in 0.001 in. units. The specimen was then secured in the clevises with spacers on either side. The upper extensometer arm knife edges were clamped at the edges of the specimen at the center line of the bottom hole and pin, and the lower end of the microformer assembly was attached to the clevis for the same hole. Thus, the deformation measured was that of the center line of the pin relative to its original position at the center of the hole.

After heating to test temperature and holding for 30 minutes. the specimen was loaded at the constant strain rate with gage length assumed to be the diameter of the hole. Yield strength was established on the basis of 2 percent of the hole diameter offset, from the straight line position of the load deformation curve. Ultimate bearing strength was calculated from the maximum load recorded.

D. Shear Tests

Where possible, pin shear data were obtained on all materials. However, in the case of the 301 (60% cold reduced) stainless steel, no 1/4-inch plate was commercially available from stock so that sheet shear data was obtained for this material.

1. Pin Shear Tests

The 1/8-inch diameter pin shear specimens were inserted in the hardened inserts in the shear plates, the control thermocouple attached, and the furnace heated to test temperature. After a soaking period of 30 minutes, a tensile load was applied through the shear plates, until the pin failed in double shear. Only the ultimate load was recorded.

2 Sheet Shear Tests

Sheet shear tests were conducted on the 301 extra hard stainless steel. The specimen configuration used was adopted after an experimental program had been carried out to determine the most appropriate half-width to shear path ratio (henceforth to be designated as w/h ratio) to be used in this series of tests. Five sets of specimens were fabricated for this program, each with a different w/h ratio. The w/h values ranged from 4 to 8. Figure 16 is a curve of shear stress versus w/h ratio, and shows that constant values of shear stress were obtained for values w/h ratios of 7 or greater. For this reason, a w/h ratio of 7 was used for sheet shear phase of the program.

After measuring the shear path and thickness, the specimens were placed into the pin and clevis holders used in the tensile tests and heated to the test temperature. After a hold time of 30 minutes, the specimens were subjected to a tensile load. The specimens sheared along the shear path h, so that the shear stress could be calculated as $\sigma_s = \frac{P}{ht}$, where P is the ultimate load measured and t is thickness of the material.

## VI. TEST RESULTS

The data resulting from individual tests are presented in tabular form in Tables 8 through 37. Curves showing the effect of temperature on the various properties investigated are also included as Figures 17 through 346. The results for the different test materials are grouped in the following order:

(1) Ph15-7Mo(Condition TH 1050) Stainless Steel

(2) AM 355

(3) René 41

(4) N-155

(5) AISI 301 (60% Cold Reduced) Stainless Steel

The tables have been grouped in the following manner for each test material:

(1) Tensile Properties, at Various Temperatures and Exposure Times

(2) Notched Tensile Tests, at Various Temperatures and Exposure Times

(3) Tensile Rupture Strengths, at Various Temperatures and Exposure Times

(4) Compressive Properties at Various Temperatures and Exposure Times

(5) Bearing Properties

(6) Shear Properties

The graphs reported have been grouped as follows for each test material:

(1) Properties, as functions of temperature, for constant exposure times. In these curves, properties are expressed as percentage of room-temperature properties. The points on these curves represent the average values shown in the tabulated data.

(2) Typical tensile stress-strain curves. Each of these curves is a reproduction of the data from one specific test, and does not represent an average.

(3) Typical curves showing tangent moduli as a function of stress for each compression test condition. Each of these curves represents the results of one specific test, rather than an average.

(4) Effect of temperature on the rupture strength of each material, based on both original and final areas.

The room temperature properties were shown on the curves for all exposure times. This was done for comparative purposes, even though the exposure times for the room temperature tests were considerably longer than 1000 hours.

## VII. DISCUSSION OF TEST RESULTS

### A. Ph15-7Mo TH 1050 Stainless Steel

The results of the tests on this material are illustrated in Figures 17 through 82 and are tabulated in Tables 8 through 13.

Figures 17 through 24 show a decrease in the ultimate tensile strength and yield strength with increasing exposure times up to the 100-hour exposure for all test temperatures. However, after 1000 hours exposure there is a marked increase in these strengths of between 5 and 13 percent over the values after 100 hours exposure. This did not occur at 1000°F test temperature, however, where a further decrease in strength of about 1 percent, from the values after the 100-hour exposure, was noted. The greatest increase of both ultimate and yield strengths was observed at 800°F. The fact that the tensile properties did not increase after 1000-hour exposure at 1000°F can probably be attributed to the relative nearness of the test temperature to the tempering temperature of the material, namely 1050°F. This prolonged exposure at 1000°F may have caused the material to have lost some of its temper, hence the decrease in strength.

Figures 58 through 64 show that tensile elongation was not greatly or consistently affected by increases in the exposure times at the various test temperatures. Changes in exposure time affected the tensile and compressive modulus of elasticity values very much in the same manner as they did the tensile strength properties, noting, however, that the compressive moduli did not change as greatly as the tensile moduli.

Figures 33 through 39 show an increase in compressive yield strength for exposure time of 1000 hours, for all temperatures except 400°F. At 400°F, an increase in compressive yield strength is noted after 10 hours exposure, with a decrease of about 3 percent of the room temperature strength, after exposures for 100 and 1000 hours.

The 1000 hours exposure did not have as marked an effect on the bearing properties as it did on the tensile and compressive properties. Only at 800°F was a significant increase in bearing strength noted after 1000 hours exposure. The ultimate bearing strength and bearing yield strength generally decreased with increasing exposure times and temperatures, but the decrease was smaller than that noted for the tensile and compressive tests. There was no significant difference in bearing properties between tests conducted with an e/D ratio of 1.5 and those conducted with an e/D ratio of 2.0, as far as percentage of room temperature properties was concerned.

The shear strength of the material showed the greatest decrease with increasing temperature (Figs. 57 through 63) falling off to about 40 percent of the room temperature value at 1000°F. Here again, however, the shear strength increased after exposure for 1000 hours, over the value observed after 100 hour exposure.

There was a significant decrease in room temperature tensile properties of the material after exposure above its tempering temperature (1050°F). The ultimate tensile strength decreased about 12 percent of its value with no exposure, and the tensile yield strength decreased about 17 percent. The decrease was greater with increasing exposure time.

B. AM 355

The tensile strength and modulus values of this material decreased moderately with increasing exposure times at 400°F. An increase in strength and modulus was observed after exposure times of 100 and 1000 hours for test temperatures of 600° and 800°F. Exposure for 10 hours increased the tensile strength and modulus at 1000°F, but these decreased with further aging.

The tensile yield strength showed a similar behavior, but the percentage of room temperature values, at elevated temperatures, were not as great as the ultimate tensile strengths.

The ultimate bearing strengths and bearing yield strengths, at both e/D ratios, exhibited increases after prolonged exposure times which were similar to the increase in tensile strengths.

Figures 99 through 105 show an increase in compressive yield strength with an increase in exposure times at 400° and 800°F. A similar increase occurs at 600°F, after 100 hours and 1000 hours exposure. Prolonged exposure does not increase the compressive yield strength at 1000°F.

This material showed a decrease in ultimate shear strength after 100 hours exposure at 600° and 800°F, although an increase was observed after this exposure time at 400° and 1000°F. The shear strength increased again after 1000 hours exposure at all temperatures except 1000°F, where it decreased to about 48 percent of the room temperature value.

As in the case of Ph15-7Mo, there was a decrease in room temperature tensile properties of AM 355, after exposure at a temperature higher than the tempering temperature (850°F). Table 5 shows that the ultimate tensile strength decreased approximately 21 percent of its value with no exposure, and the tensile yield strength decreased about 16 percent. Figure 15 shows that these properties decreased with increasing exposure time.

C. René 41

Figures 149 through 155 show that increased exposure times had virtually no effect on the ultimate tensile strength of the material at 600°F. At the higher test temperatures of 900° and 1200°F, increased exposure times cause an increase in ultimate tensile strength, after 100 and 1000 hours exposure. At 1400°F, the aging temperature during heat treating, and above, the increased exposure times tend to decrease the ultimate tensile strength for this material.

The tensile yield strength increases with exposure time at 600°, 900° and 1200°F, after 100 and 1000 hours exposure, and exhibits a decrease in strength at 1400° and 1500°F, after exposure, similar to the decrease in ultimate tensile strength.

Tensile tests on this material at 900° and 1200°F produced a fairly discernible popping and cracking noise, during loading, which showed up as irregularities on the yield portions of some of the tensile stress-strain curves. This was investigated further, and in checking with the Haynes Stellite Company, it was learned that they had experienced similar behavior in tests on some of their other alloys. This behavior could probably best be explained as a mechanism of slip propagation where the grains or series of grains in the metal were not aligned most favorably in this particular straining direction, and as they failed, they emitted this popping and cracking noise.

Figures 173 through 188 show that the ultimate bearing strength and bearing yield strength behavior of this material is similar to its tensile strength behavior. The bearing properties generally increased, with increased exposure times for 600°, 900°, ar ˙?00°F, but then decreased at 1400° and 1500°F. There was practically no differe ce between the results for both e/D ratios, as far as percentage of room temperature properties was concerned.

Table 20 shows that this material retained much of its room temperature hardness at elevated temperatures up to 1400°F. (This presented some difficulty in testing René 41 in pin shear, as it was harder at elevated temperatures than the first material used for the hardened shear inserts. This difficulty was readily overcome, however, by changing to Waspaloy inserts.)

Figures 203 through 206 show that for the 0.5 hour exposure, the ultimate strength of the material (as represented by the peak of the stress-strain curve) shifts to the right as the temperature is increased up to 900°F, whereas from 900° to 1500°F, the shift is to the left. This trend was found, in general, to reverse itself for longer exposure periods.

## D. N-155 (Multimet)

Figures 215 through 280 and Tables 26 through 31 show the test results for this alloy.

Figures 215 through 222 show that generally the ultimate tensile strength decreased with increased exposure times. The tensile yield strength at 1400°F increased with increased exposure after 10 and 100 hours, but decreased approximately 10 percent of room temperature strength after 1000 hours exposure. The yield strength decreased gradually with increased exposure times at 1600°, 1800°, and 1900°F.

The bearing yield strength increased after all exposures at 1400°F and after the 10-hour exposure at 1600° and 1800°F. Increased exposure times at

1900°F had no consistent effect on the bearing yield strength. These results are presented in Figures 239 through 254.

Figures 255 through 261 show that exposure time had little effect on the ultimate shear strength of this material. The most significant change observed was the decrease noted after the 1000 hour exposure at 1600°F where the shear strength dropped about 5 percent of the room temperature strength from the value observed after 0.5 hours exposure.

Increased exposure times had no significant or consistent effect on tensile elongation. The greatest amount of elongation occurred after the 100 hour exposure at 1600°F.

Figures 231 through 238 show that the compressive properties at elevated temperatures did not decrease from the room temperature properties as much as the tensile properties. At 1400°F, the compressive yield strength and compressive modulus of elasticity were about 75 percent of the room temperature values, while the tensile strengths at 1400°F had decreased to 51 percent of the room temperature values.

The compressive properties showed a slight decrease with increasing exposure times at the elevated temperatures.

E. AISI Type 301 (60% Cold Reduced) Stainless Steel

Figures 281 through 346 and Tables 32 through 37 show the test results for this alloy.

At temperatures of 400° and 600°F, increased tensile strength properties were observed with increases in exposure times. At 800° and 1000°F, the tensile strength properties decreased with increasing exposure times, with the exception of the 10 hour exposure of 1000°F. A slight increase, of about 3 percent of room temperature ultimate tensile strength and tensile yield strength, was observed after this exposure, with a decrease upon further aging.

Figures 289 through 296 show that the notched tensile strengths and tensile moduli of elasticity followed the same general trend as the tensile strengths, although a slight increase in these properties was observed after the 10 hour exposure at 800°F.

Figures 305 through 320 show that the bearing properties were reasonably constant with increasing exposure times for both e/D = ratios, up to 800°F. At 800°F, the bearing yield strength for e/D = 1.5 decreased to a value 59 percent of the room temperature value, after 1000 hours exposure, while for e/D = 2.0 it remained at about 70 percent of the room temperature value at 800°F, after 1000 hours. At 1000°F, both bearing yield strength and ultimate bearing strength decreased appreciably, with increasing exposure times.

Figures 297 through 304 show a peculiar behavior of this material in its compressive properties. At 400° and 600° F, there is a substantial increase in compressive yield strength and compressive modulus of elasticity with an increase in exposure times, so that after 10 hours exposure at 400° F, the compressive yield strength increases to a value slightly higher than the value at room temperature and increases even more after 100 and 1000 hours exposure. This increase in properties is noted at 800° F, after 100 and 1000 hours exposure, and at 1000° F after 10 hours exposure. At 1000° F, after 100 and 1000 hours exposure, the compressive strength properties decrease.

The increases in strength, after exposure, can probably be linked to the severe cold working this material has undergone. The residual stresses that were induced in the material at the time of cold working were relieved, after exposure at elevated temperatures, so that increased strength levels would be observed. After 10 hours exposure at 1000° F, the residual stresses have probably been completely relieved, so that further exposure then had a weakening effect on the material.

The ductility of this material in tension was uniformly low at temperatures up to 1000° F. The greatest ductility, in terms of elongation, was observed at 1000° F, the elongation being not appreciably affected by changes in exposure time.

# VIII. CONCLUSIONS

The data on the materials presented in this report are considered representative of the material as commercially stocked. No effort was made to obtain material other than that commercially available.

In general, the strength properties of these five materials decreased with increasing temperature over the range investigated at the lower exposure times of 0.5 and 10 hours. However, Ph15-7Mo and AM 355 showed substantial increases in strengths after exposure for 100 and 1000 hours at 800°F and smaller increases at 600°F. At the higher test temperatures for each particular alloy, however, all materials showed a decrease in strength with increasing exposure times.

Increased exposure times had the least effect on René 41 over the temperature range for which it was designed. At the higher temperature of 1500°F, exposure time had slightly more effect, and this only after the 1000-hour exposure.

N-155 generally showed the most gradual decrease in strength properties, with increasing temperature, of all the materials tested. The 301 stainless steel exhibited the most significant change in strength properties, when testing temperature was increased from 800° to 1000°F, as its tensile strengths decreased from about 80 percent of room temperature values at 800°F to around 33 percent at 1000°F.

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TABLE 1. TEST TEMPERATURES FOR MATERIALS INVESTIGATED

| Material | Code Letter | Testing Temperature (°F) |
|---|---|---|
| Ph15-7Mo Condition TH1050 | B | Room, 400, 600, 800, 1000 |
| 301 (60% Cold Reduced) Stainless Steel | D | Room, 400, 600, 800, 1000 |
| AM-355 | E | Room, 400, 600, 800, 1000 |
| René 41 | F | Room, 600, 900, 1200, 1400, 1500 |
| N-155 (Multimet) | G | Room, 1400, 1600, 1800, 1900 |

TABLE 2. CHEMICAL COMPOSITIONS OF MATERIALS TESTED

(A. 0.050" Sheet)

Multimet - N-155 - Heat M-5533

| Cr | W | Fe | C | Si | Co | Ni | Mn | Cb + Ta | Mo | $N_2$ | P | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.20 | 2.50 | Bal | .10 | .68 | 19.80 | 20.00 | 1.52 | .94 | 2.92 | .11 | .013 | .011 |

René 41 - Heat TV294

| Cr | Fe | C | Si | Co | Ni | Mn | Mo | P | S | Al | Ti | B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18.99 | .63 | .06 | .10 | 11.26 | Bal | .01 | 9.95 | .001 | .004 | 1.53 | 3.17 | .006 |

301 Stainless Steel - Heat 153015

| C | Mn | P | S | Si | Cr | Ni |
|---|---|---|---|---|---|---|
| 0.09 | 1.24 | .030 | .014 | .56 | 17.25 | 7.25 |

AM-355 - Heat 89232

| C | Mn | P | S | Si | Cr | Ni | Mo | $N_2$ |
|---|---|---|---|---|---|---|---|---|
| .13 | .81 | .014 | .016 | .30 | 15.09 | 4.27 | 2.55 | .10 |

Ph15-7Mo - Heat 890681

| C | Mn | P | S | Si | Cr | Ni | Al | Mo |
|---|---|---|---|---|---|---|---|---|
| .075 | .56 | .016 | .013 | .35 | 14.98 | 7.48 | 1.06 | 2.16 |

TABLE 2. CHEMICAL COMPOSITIONS OF MATERIALS TESTED (Cont'd)

(B. 1/4" Plate)

Multimet - N-155 - Heat M-5506

| Cr | W | Fe | C | Si | Co | Ni | Mn | Cb + Ta | Mo | $N_2$ | P | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20.84 | 2.58 | Bal | .11 | .59 | 20.49 | 19.63 | 1.43 | .93 | 3.01 | .11 | .011 | .015 |

René 41 - Heat TV-363

| Cr | Fe | C | Si | Co | Ni | Mn | Mo | P | S | Al | Ti | B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19.10 | .79 | .04 | .10 | 10.99 | Bal | .07 | 10.14 | .001 | .008 | 1.55 | 3.14 | .006 |

AM-355 - Heat 69803

| C | Mn | P | S | Si | Cr | Ni | Mo | $N_2$ |
|---|---|---|---|---|---|---|---|---|
| .13 | .80 | .017 | .017 | .30 | 15.69 | 4.14 | 2.94 | .090 |

Ph15-7Mo - Heat 49487-2A

| C | Mn | P | S | Si | Cr | Ni | Al | Mo |
|---|---|---|---|---|---|---|---|---|
| .073 | .56 | .022 | .013 | .41 | 14.85 | 2.32 | 1.21 | 2.24 |

TABLE 3. CHEMICAL RANGE REQUIREMENTS

René 41 - AMS Spec. No. 5545

| | |
|---|---|
| Carbon (C) | 0.12 max |
| Manganese (Mn) | 0.10 max |
| Silicon (Si) | 0.50 max |
| Sulfur (S) | 0.015 max |
| Chromium (Cr) | 18.00 - 20.00 |
| Cobalt (Co) | 10.00 - 12.00 |
| Molybdenum (Mo) | 9.00 - 10.50 |
| Iron (Fe) | 5.00 max |
| Titanium (Ti) | 3.00 - 3.30 |
| Aluminum (Al) | 1.40 - 1.60 |
| Boron (B) | 0.0030 - 0.010 |
| Nickel (Ni) | Remainder |

Ph15-7Mo - AMS Spec. No. 5520A

| | |
|---|---|
| Carbon (C) | 0.09 max |
| Manganese (Mn) | 1.00 max |
| Silicon (Si) | 1.00 max |
| Phosphorus (P) | 0.04 max |
| Sulphur (S) | 0.03 max |
| Chromium (Cr) | 14.00 - 16.00 |

TABLE 3. CHEMICAL RANGE REQUIREMENTS (Cont'd)

### Ph15-7Mo - AMS Spec. No. 5520A (Cont'd)

| | |
|---|---|
| Nickel (Ni) | 650 - 775 |
| Molybdenum (Mo) | 2.00 - 3.00 |
| Aluminum (Al) | 0.75 - 1.50 |

### AM 355 - AMS Spec. No. 5547A

| | |
|---|---|
| Carbon (C) | 0.10 - 0.15 |
| Manganese (Mn) | 0.50 - 1.25 |
| Silicon (Si) | 0.50 max |
| Phosphorus (P) | 0.040 max |
| Sulphur (S) | 0.030 max |
| Chromium (Cr) | 15.00 - 16.00 |
| Nickel (Ni) | 4.00 - 5.00 |
| Molybdenum (Mo) | 2.50 - 3.25 |
| Nitrogen ($N_2$) | 0.07 - 0.13 |

### N-155 Multimet - AMS Spec. No. 5532B

| | |
|---|---|
| Carbon (C) | 0.08 - 0.16 |
| Manganese (Mn) | 1.00 - 2.00 |
| Silicon (Si) | 1.00 max |
| Phosphorus (P) | 0.040 max |
| Sulphur (S) | 0.030 max |

TABLE 3. CHEMICAL RANGE REQUIREMENTS (Cont'd)

N-155 Multimet - AMS Spec. No. 5532B (Cont'd)

| | |
|---|---|
| Chromium (Cr) | 20.00 - 22.50 |
| Nickel (Ni) | 19.00 - 21.00 |
| Cobalt (Co) | 18.50 - 21.00 |
| Molybdenum (Mo) | 2.50 - 3.50 |
| Tungsten (W) | 2.00 - 3.00 |
| Columbium + Tantalum (Cb + Ta) | 0.75 - 1.25 |
| Nitrogen ($N_2$) | 0.10 - 0.20 |
| Iron (Fe) | Remainder |

301 Stainless Steel - AMS Spec. No. 5519E

| | |
|---|---|
| Carbon (C) | 0.15 max |
| Manganese (Mn) | 2.00 max |
| Phosphorus (P) | 0.040 max |
| Sulphur (S) | 0.030 max |
| Silicon (Si) | 1.00 max |
| Chromium (Cr) | 17.00 min |
| Nickel (Ni) | 7.00 min |
| Molybdenum (Mo) | 0.50 max |
| Copper (Cu) | 0.50 max |

TABLE 4. MILL REPORTS OF MECHANICAL PROPERTIES

| Material | Yield Strength (0.2% offset psi) | Ultimate Tensile Strength (psi) | Elongation (% in 2") | Hardness |
|---|---|---|---|---|
| | | **A. 0.050" Sheet** | | |
| **N-155 (Multimet)** | **52,100** | **108,950** | **50.0** | **RB 92** |
| **AM-355** | **176,340** | **207,940** | **12.0** | **RC 45** |
| **René 41** | **81,400** | **147,000** | **40.0** | **RB 98** |
| **Ph15-7Mo** | **50,400** | **127,200** | **41.5** | **RB 85** |
| **301 Stainless Steel** | **246,000** | **262,000** | **6.5** | **RC 52** |
| | | **B. 1/4" Plate** | | |
| **N-155 (Multimet)** | **53,900** | **112,100** | **51.0** | **RB 92** |
| **AM-355** | **60,410** | **186,010** | **36.0** | **RB 98** |
| **René 41** | **79,500** | **131,000** | **44.0** | **RB 95** |
| **Ph15-7Mo** | **77,375** | **132,925** | **25.0** | **RC 22** |

TABLE 5. ROOM TEMPERATURE TENSILE PROPERTIES OF Ph15-7Mo AND AM 355 AFTER EXPOSURE ABOVE TEMPERING TEMPERATURE

| Specimen Number | Exposure Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi$\times 10^{-6}$) | Elongation in 2 Inches (%) |
|---|---|---|---|---|---|---|
| | | | AM 355 | | | |
| E 44A | 950 | 0.5 | 177.20 | 159.20 | 30.47 | 12.5 |
| E 16A | 950 | 0.5 | 170.11 | 152.87 | 29.26 | 12.5 |
| | | Average | 173.66 | 156.04 | 29.87 | 12.5 |
| E 13A | 950 | 10 | 161.30 | 131.42 | 27.57 | 14.0 |
| E 66A | 950 | 10 | 161.30 | 131.42 | 27.37 | 14.3 |
| | | Average | 161.30 | 131.42 | 27.47 | 14.2 |
| E 102A | 950 | 100 | 156.13 | 114.94 | 26.98 | 15.5 |
| E 14A | 950 | 100 | 155.17 | 112.64 | 26.46 | 16.2 |
| | | Average | 155.65 | 113.79 | 26.72 | 15.9 |
| E 54A | 950 | 1000 | 146.36 | 100.38 | 23.00 | 16.6 |
| E 93A | 950 | 1000 | 144.06 | 99.23 | 23.16 | 16.5 |
| | | Average | 145.21 | 99.81 | 23.08 | 16.6 |

TABLE 5. ROOM TEMPERATURE TENSILE PROPERTIES OF Ph15-7Mo AND AM 355 AFTER EXPOSURE ABOVE TEMPERING TEMPERATURE (Cont'd)

| Specimen Number | Exposure Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi×$10^{-6}$) | Elongation in 2 Inches (%) |
|---|---|---|---|---|---|---|
| | | | Ph 15-7Mo TH 1050 | | | |
| B 62A | 1100 | 0.5 | 171.64 | 147.39 | 27.97 | 13.8 |
| B 88A | 1100 | 0.5 | 173.18 | 147.51 | 27.97 | 13.5 |
| | | Average | 172.41 | 147.45 | 27.97 | 13.7 |
| B 51A | 1100 | 10 | 152.87 | 117.24 | 24.90 | 12.8 |
| B 93A | 1100 | 10 | 153.26 | 119.92 | 25.10 | 13.0 |
| | | Average | 153.07 | 118.58 | 25.00 | 12.9 |
| B 56A | 1100 | 100 | 142.53 | 98.85 | 23.75 | 14.5 |
| B 95A | 1100 | 100 | 144.06 | 100.00 | 23.95 | 15.1 |
| | | Average | 143.30 | 99.43 | 23.85 | 14.8 |
| B 34A | 1100 | 1000 | 136.40 | 95.40 | 22.45 | 17.5 |
| B 97A | 1100 | 1000 | 132.95 | 92.72 | 22.61 | 17.4 |
| | | Average | 134.68 | 94.06 | 22.53 | 17.5 |

TABLE 6. TENSILE TESTS OF 1/4-INCH PLATE MATERIALS

| Material | Specimen Number | Tensile Strength (ksi) | Hardness (Rockwell) |
|---|---|---|---|
| AM 355 | E 1A | 209.69 | C 46.0 |
| | E 2A | 210.68 | C 47.0 |
| | Average | 210.19 | C 46.5 |
| René 41 | F 1A | 187.24 | C 44.0 |
| | F 2A | 186.57 | C 45.5 |
| | Average | 186.91 | C 44.8 |
| Ph 15-7Mo | B 1A | 195.20 | C 42.5 |
| | B 2A | 194.40 | C 43.0 |
| | Average | 194.80 | C 42.8 |
| N-155 | G 1A | 112.12 | B 92.0 |
| | G 2A | 111.90 | B 94.0 |
| | Average | 112.01 | B 93.0 |

TABLE 7. ROOM TEMPERATURE SHEET SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS w/h RATIOS

| Specimen Number | w (in.) | h (in.) | w/h | Ultimate Shear Strength (ksi) |
|---|---|---|---|---|
| DF 1 | 0.750 | 0.1875 | 4 | 168.37 |
| DF 2 | 0.750 | 0.1875 | 4 | 166.28 |
| DF 3 | 0.750 | 0.1875 | 4 | 169.42 |
| | Average | | | 168.02 |
| DF 4 | 0.750 | 0.150 | 5 | 173.86 |
| DF 5 | 0.750 | 0.150 | 5 | 173.86 |
| DF 6 | 0.750 | 0.150 | 5 | 176.47 |
| | Average | | | 174.73 |
| DF 7 | 0.750 | 0.125 | 6 | 174.40 |
| DF 8 | 0.750 | 0.125 | 6 | 177.60 |
| DF 9 | 0.750 | 0.125 | 6 | 175.20 |
| | Average | | | 175.73 |
| DF 10 | 0.750 | 0.107 | 7 | 179.59 |
| DF 11 | 0.750 | 0.107 | 7 | 181.51 |
| DF 12 | 0.750 | 0.107 | 7 | 179.59 |
| | Average | | | 180.23 |
| DF 13 | 0.750 | 0.0938 | 8 | 181.24 |
| DF 14 | 0.750 | 0.0938 | 8 | 182.40 |
| DF 15 | 0.750 | 0.0938 | 8 | 180.17 |
| | Average | | | 181.27 |

TABLE 8. TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| B 66A(T)* | Room | -- | 194.60 | 175.10 | 28.80 | 8.5 | C 42.0 |
| B 86A | | -- | 195.56 | 175.40 | 28.10 | 8.7 | C 42.5 |
| B 36A | | -- | 196.60 | 180.00 | 28.81 | 8.6 | C 41.0 |
| | | Average | 195.59 | 176.83 | 28.57 | 8.6 | C 41.8 |
| B 83A | 400 | 0.5 | 173.98 | 160.16 | 27.23 | 5.5 | C 40.5 |
| B 13A | | 0.5 | 175.40 | 160.10 | 27.00 | 5.2 | C 40.0 |
| B 144A | | 0.5 | 175.30 | 161.00 | 27.20 | 5.0 | C 39.0 |
| | | Average | 174.89 | 160.42 | 27.14 | 5.2 | C 39.8 |
| B 26A | | 10 | 170.11 | 157.83 | 27.01 | 4.7 | C 39.5 |
| B 41A | | 10 | 169.73 | 160.15 | 27.01 | 4.8 | C 40.0 |
| B 142A | | 10 | 169.35 | 157.09 | 26.92 | 5.0 | C 39.5 |
| | | Average | 169.73 | 158.36 | 26.98 | 4.8 | C 39.6 |
| B 31A | | 100 | 165.90 | 154.02 | 26.82 | 5.1 | C 39.0 |
| B 52A | | 100 | 167.05 | 154.79 | 26.82 | 5.2 | C 38.5 |
| B 94A | | 100 | 164.40 | 151.00 | 27.01 | 5.1 | C 38.5 |
| | | Average | 165.78 | 153.27 | 26.88 | 5.1 | C 38.6 |
| B 71A | | 1000 | 183.67 | 164.90 | 26.73 | 5.7 | C 39.5 |
| B 32A | | 1000 | 175.61 | 154.88 | 26.51 | 5.5 | C 40.0 |
| B 24A | | 1000 | 180.08 | 160.15 | 26.82 | 5.8 | C 39.5 |
| | | Average | 179.79 | 159.98 | 26.69 | 5.7 | C 39.6 |

*Tuckerman Optical Strain Gage

TABLE 8. TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi X $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| B 92A | 600 | 0.5 | 165.13 | 147.51 | 26.25 | 4.0 | C 34.0 |
| B 61A | | 0.5 | 165.52 | 147.89 | 26.25 | 3.8 | C 35.5 |
| B 46A | | 0.5 | 165.90 | 147.89 | 26.34 | 3.8 | C 35.0 |
| | | Average | 165.52 | 147.76 | 26.28 | 3.9 | C 34.8 |
| B 84A | | 10 | 162.07 | 146.51 | 26.05 | 5.0 | C 34.0 |
| B 93A | | 10 | 163.79 | 146.74 | 26.05 | 4.0 | C 34.0 |
| B 146A | | 10 | 162.45 | 145.59 | 25.96 | 3.9 | C 33.0 |
| | | Average | 162.77 | 146.28 | 26.02 | 4.3 | C 33.6 |
| B 91A | | 100 | 160.15 | 145.98 | 26.05 | 5.6 | C 34.5 |
| B 43A | | 100 | 159.00 | 143.68 | 25.96 | 5.7 | C 34.0 |
| B 22A | | 100 | 159.00 | 145.21 | 25.86 | 5.5 | C 32.5 |
| | | Average | 159.38 | 144.96 | 25.96 | 5.6 | C 33.6 |
| B 74A | | 1000 | 169.35 | 145.21 | 26.05 | 5.7 | C 37.5 |
| B 65A | | 1000 | 169.73 | 147.51 | 25.86 | 5.4 | C 37.0 |
| B 141A | | 1000 | 170.50 | 145.59 | 25.86 | 5.8 | C 36.5 |
| | | Average | 169.86 | 146.10 | 25.92 | 5.6 | C 37.0 |

TABLE 8. TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi X $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| B 82A | 800 | 0.5 | 150.96 | 132.95 | 24.90 | 12.0 | C 34.0 |
| B 35A | | 0.5 | 153.26 | 134.87 | 25.29 | 11.5 | C 33.5 |
| B 67A | | 0.5 | 152.94 | 134.90 | 25.10 | 11.9 | C 33.5 |
| | | Average | 152.39 | 134.24 | 25.10 | 11.8 | C 33.6 |
| B 18A | | 10 | 149.20 | 130.10 | 23.67 | 10.4 | C 31.0 |
| B 57A | | 10 | 149.80 | 126.82 | 24.71 | 10.1 | C 32.0 |
| B 72A | | 10 | 149.02 | 127.97 | 24.71 | 10.5 | C 32.5 |
| | | Average | 149.34 | 128.30 | 24.36 | 10.3 | C 31.8 |
| B 147A | | 100 | 148.60 | 128.00 | 23.60 | 10.6 | C 34.0 |
| B 54A | | 100 | 144.83 | 125.67 | 24.71 | 11.0 | C 31.5 |
| B 11A | | 100 | 144.06 | 124.90 | 24.51 | 11.0 | C 31.0 |
| | | Average | 145.83 | 126.19 | 24.27 | 10.9 | C 32.1 |
| B 87A | | 1000 | 172.20 | 150.61 | 25.91 | 11.7 | C 38.5 |
| B 77A | | 1000 | 171.40 | 147.30 | 25.91 | 11.1 | C 38.0 |
| B 27A | | 1000 | 170.11 | 149.80 | 26.09 | 10.7 | C 38.0 |
| | | Average | 171.22 | 149.23 | 25.90 | 11.2 | C 38.1 |

TABLE 8. TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| B 96A | 1000 | 0.5 | 102.68 | 82.76 | 22.22 | 20.5 | C 30.0 |
| B 14A | | 0.5 | 104.98 | 83.14 | 22.41 | 23.6 | C 28.0 |
| B 45A | | 0.5 | 102.30 | 85.00 | 22.23 | 22.2 | C 29.0 |
| | | Average | 103.32 | 83.63 | 22.29 | 22.1 | C 29.0 |
| B 33A | | 10 | 102.10 | 82.40 | 22.20 | 24.8 | C 23.0 |
| B 85A | | 10 | 101.96 | 81.96 | 22.35 | 25.1 | C 24.0 |
| B 53A | | 10 | 103.53 | 82.35 | 22.75 | 24.3 | C 23.0 |
| | | Average | 102.53 | 82.24 | 22.43 | 24.7 | C 23.3 |
| B 143A | | 100 | 100.10 | 79.80 | 21.9 | 22.0 | C 24.0 |
| B 73A | | 100 | 100.00 | 80.00 | 22.55 | 21.9 | C 23.0 |
| B 16A | | 100 | 98.82 | 79.22 | 22.55 | 22.6 | C 22.0 |
| | | Average | 99.64 | 79.67 | 22.33 | 22.2 | C 23.0 |
| B 37A | | 1000 | 94.50 | 76.24 | 22.10 | 20.4 | C 20.0 |
| B 81A | | 1000 | 97.65 | 80.23 | 21.91 | 20.8 | C 21.0 |
| B 26A | | 1000 | 96.47 | 78.43 | 21.96 | 20.3 | C 20.0 |
| | | Average | 96.21 | 78.30 | 21.99 | 20.5 | C 20.3 |

TABLE 9. NOTCHED TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| B 94B | Room | -- | 214.32 | |
| B 71B | | -- | 213.38 | |
| B 43B | | -- | 212.39 | |
| | | Average | 213.36 | 1.091 |
| B 63B | 400 | 0.5 | 186.49 | |
| B 14B | | 0.5 | 185.21 | |
| B 82B | | 0.5 | 186.44 | |
| | | Average | 186.05 | 1.063 |
| B 12B | | 10 | 181.27 | |
| B 73B | | 10 | 180.12 | |
| B 31B | | 10 | 180.12 | |
| | | Average | 180.50 | 1.056 |
| B 92B | | 100 | 172.32 | |
| B 54B | | 100 | 173.46 | |
| B 13B | | 100 | 173.28 | |
| | | Average | 173.02 | 1.044 |
| B 66B | | 1000 | 192.39 | |
| B 86B | | 1000 | 191.63 | |
| B 55B | | 1000 | 192.25 | |
| | | Average | 192.09 | 1.068 |

TABLE 9. NOTCHED TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| B 52B | 600 | 0.5 | 170.03 | |
| B 93B | | 0.5 | 171.20 | |
| B 22B | | 0.5 | 169.08 | |
| | | Average | 170.10 | 1.028 |
| B 41B | | 10 | 168.00 | |
| B 95B | | 10 | 169.04 | |
| B 24B | | 10 | 168.75 | |
| | | Average | 168.60 | 1.036 |
| B 11B | | 100 | 163.83 | |
| B 83B | | 100 | 163.67 | |
| B 56B | | 100 | 162.11 | |
| | | Average | 163.20 | 1.024 |
| B 75B | | 1000 | 177.80 | |
| B 65B | | 1000 | 181.60 | |
| B 34B | | 1000 | 180.00 | |
| | | Average | 179.80 | 1.065 |
| B 64B | 800 | 0.5 | 157.97 | |
| B 85B | | 0.5 | 158.17 | |
| B 32B | | 0.5 | 157.14 | |
| | | Average | 157.76 | 1.035 |
| B 72B | | 10 | 154.98 | |
| B 62B | | 10 | 155.16 | |
| B 21B | | 10 | 155.56 | |
| | | Average | 155.23 | 1.039 |
| B 25B | | 100 | 153.78 | |
| B 51B | | 100 | 154.18 | |
| B 91B | | 100 | 152.59 | |
| | | Average | 153.52 | 1.053 |
| B 35B | | 1000 | 173.60 | |
| B 42B | | 1000 | 173.76 | |
| B 96B | | 1000 | 174.60 | |
| | | Average | 173.99 | 1.016 |

TABLE 9. NOTCHED TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| B 102B | 1000 | 0.5 | 107.91 | |
| B 45B | | 0.5 | 108.94 | |
| B 76B | | 0.5 | 107.97 | |
| | | Average | 108.27 | 1.048 |
| B 46B | | 10 | 107.14 | |
| B 81B | | 10 | 106.35 | |
| B 23B | | 10 | 106.75 | |
| | | Average | 106.75 | 1.041 |
| B 16B | | 100 | 104.56 | |
| B 84B | | 100 | 104.96 | |
| B 44B | | 100 | 104.92 | |
| | | Average | 104.81 | 1.052 |
| B 74B | | 1000 | 102.38 | |
| B 61B | | 1000 | 102.38 | |
| B 101B | | 1000 | 102.38 | |
| | | Av rage | 102.38 | 1.064 |

TABLE 10. RUPTURE STRENGTHS OF PH15-7Mo BASED ON BOTH ORIGINAL AND FINAL AREAS

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| B 66A | Room | -- | 163.4 | 220.9 |
| B 86A | | -- | 165.4 | 210.4 |
| B 36A | | -- | 164.0 | 209.2 |
| | | Average | 164.3 | 213.5 |
| B 83A | 400 | 0.5 | 156.9 | 209.7 |
| B 13A | | 0.5 | 158.5 | 200.0 |
| B 144A | | 0.5 | 154.5 | 253.9 |
| | | Average | 156.6 | 221.2 |
| B 26A | | 10 | 153.6 | 237.3 |
| B 41A | | 10 | 151.7 | 218.8 |
| B 142A | | 10 | 150.4 | 233.6 |
| | | Average | 151.9 | 229.9 |
| B 31A | | 100 | 151.3 | 187.2 |
| B 52A | | 100 | 147.5 | 182.5 |
| B 94A | | 100 | 149.8 | 195.5 |
| | | Average | 149.5 | 188.4 |
| B 71A | | 1000 | 159.2 | 190.6 |
| B 32A | | 1000 | 151.2 | 199.6 |
| B 24A | | 1000 | 153.3 | 204.1 |
| | | Average | 154.5 | 198.1 |

TABLE 10. RUPTURE STRENGTHS OF Ph15-7Mo BASED BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| B 92A | 600 | 0.5 | 146.0 | 167.8 |
| B 61A | | 0.5 | 146.3 | 165.4 |
| B 46A | | 0.5 | 147.1 | 167.4 |
| | | Average | 146.4 | 166.8 |
| B 84A | | 10 | 147.1 | 177.8 |
| B 93A | | 10 | 147.1 | 196.9 |
| B 146A | | 10 | 151.3 | 182.9 |
| | | Average | 148.5 | 185.8 |
| B 91A | | 100 * | 150.2 | 176.6 |
| B 43A | | 100 | 146.3 | 176.9 |
| B 22A | | 100 | 146.0 | 171.6 |
| | | Average | 147.5 | 175.0 |
| B 74A | | 1000 | 152.5 | 204.6 |
| B 65A | | 1000 | 153.5 | 205.1 |
| B 141A | | 1000 | 151.3 | 199.5 |
| | | Average | 152.4 | 203.0 |
| B 82A | 800 | 0.5 | 129.9 | 204.2 |
| B 35A | | 0.5 | 134.1 | 200.5 |
| B 67A | | 0.5 | 136.0 | 202.6 |
| | | Average | 133.3 | 202.4 |
| B 18A | | 10 | 139.3 | 208.6 |
| B 57A | | 10 | 140.0 | 215.1 |
| B 72A | | 10 | 138.4 | 217.5 |
| | | Average | 139.2 | 213.7 |
| B 147A | | 100 | 138.4 | 208.4 |
| B 54A | | 100 | 135.3 | 207.8 |
| B 11A | | 100 | 133.3 | 201.2 |
| | | Average | 135.7 | 205.8 |
| B 87A | | 1000 | 146.9 | 192.5 |
| B 77A | | 1000 | 155.1 | 183.1 |
| B 27A | | 1000 | 163.3 | 188.9 |
| | | Average | 155.1 | 188.1 |

TABLE 10. RUPTURE STRENGTHS OF Ph15-7Mo BASED ON BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| B 96A | 1000 | 0.5 | 84.3 | 205.6 |
| B 14A | | 0.5 | 87.0 | 224.8 |
| B 45A | | 0.5 | 95.6 | 220.4 |
| | | Average | 88.9 | 216.9 |
| B 33A | | 10 | 93.5 | 236.1 |
| B 85A | | 10 | 96.1 | 242.6 |
| B 53A | | 10 | 94.1 | 230.8 |
| | | Average | 94.5 | 236.5 |
| B 143A | | 100 | 93.9 | 233.3 |
| B 73A | | 100 | 93.3 | 235.6 |
| B 16A | | 100 | 91.8 | 228.1 |
| | | Average | 93.0 | 232.3 |
| B 37A | | 1000 | 66.9 | 111.5 |
| B 81A | | 1000 | 64.8 | 130.0 |
| B 26A | | 1000 | 65.1 | 123.9 |
| | | Average | 65.6 | 121.8 |

TABLE 11. COMPRESSIVE PROPERTIES OF PH15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi X $10^{-6}$) |
|---|---|---|---|---|
| B 5354E | Room | -- | 200.96 | 29.45 |
| B 34E | | -- | 202.99 | 29.62 |
| B 4344E | | -- | 211.20 | 29.76 |
| | | Average | 205.05 | 29.61 |
| B 46E | 400 | 0.5 | 178.56 | 27.84 |
| B 61E | | 0.5 | 190.08 | 27.84 |
| B 16E | | 0.5 | 184.00 | 28.64 |
| | | Average | 184.21 | 28.11 |
| B 15E | | 10 | 200.96 | 27.20 |
| B 93E | | 10 | 187.84 | 28.80 |
| B 54E | | 10 | 185.92 | 27.84 |
| | | Average | 191.57 | 27.94 |
| B 12E | | 100 | 183.04 | 27.68 |
| B 75E | | 100 | 178.56 | 27.52 |
| B 93E | | 100 | 185.60 | 28.32 |
| | | Average | 182.40 | 27.84 |
| B 91E | | 1000 | 191.04 | 27.52 |
| B 76E | | 1000 | 171.84 | 28.00 |
| B 56E | | 1000 | 185.28 | 28.16 |
| | | Average | 182.72 | 27.90 |

TABLE 11. COMPRESSIVE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi × $10^{-6}$) |
|---|---|---|---|---|
| B 44E | 600 | 0.5 | 180.48 | 26.40 |
| B 63E | | 0.5 | 175.36 | 26.72 |
| B 94E | | 0.5 | 165.12 | 26.24 |
| | | Average | 173.65 | 26.45 |
| B 8586E | | 10 | 170.88 | 26.56 |
| B 33E | | 10 | 187.20 | 26.72 |
| B 72E | | 10 | 179.52 | 26.40 |
| | | Average | 179.20 | 26.56 |
| B 15E | | 100 | 173.76 | 26.72 |
| B 83E | | 100 | 180.48 | 26.72 |
| B 51E | | 100 | 177.92 | 26.40 |
| | | Average | 177.39 | 26.61 |
| B 52E | | 1000 | 188.16 | 26.72 |
| B 8182E | | 1000 | 185.92 | 27.04 |
| B 84E | | 1000 | 186.24 | 27.20 |
| | | Average | 186.77 | 26.99 |
| B 11E | 800 | 0.5 | 164.80 | 26.40 |
| B 36E | | 0.5 | 166.40 | 25.44 |
| B 86E | | 0.5 | 168.00 | 25.44 |
| | | Average | 166.33 | 25.76 |
| B 45E | | 10 | 162.56 | 25.44 |
| B 53E | | 10 | 164.16 | 26.08 |
| B 14E | | 10 | 156.16 | 25.12 |
| | | Average | 160.96 | 25.55 |
| B 95E | | 100 | 161.92 | 25.12 |
| B 71E | | 100 | 160.00 | 25.12 |
| B 32E | | 100 | 156.16 | 25.92 |
| | | Average | 159.36 | 25.39 |
| B 81E | | 1000 | 174.08 | 26.08 |
| B 6162E | | 1000 | 176.00 | 26.24 |
| B 9596E | | 1000 | 172.80 | 26.08 |
| | | Average | 174.29 | 26.13 |

TABLE 11. COMPRESSIVE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (° F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec psi $\times 10^{-6}$) |
|---|---|---|---|---|
| B 13E | 1000 | 0.5 | 115.64 | 22.56 |
| B 62E | | 0.5 | 122.24 | 22.40 |
| B 41E | | 0.5 | 117.76 | 22.72 |
| | | Average | 118.55 | 22.56 |
| B 35E | | 10 | 103.08 | 20.32 |
| B 55E | | 10 | 101.60 | 23.20 |
| B 92E | | 10 | 104.00 | 21.76 |
| | | Average | 102.89 | 21.76 |
| B 194E | | 100 | 101.60 | 22.80 |
| B 73E | | 100 | 100.00 | 21.20 |
| B 21E | | 100 | 104.96 | 22.08 |
| | | Average | 102.19 | 22.03 |
| B 7172E | | 1000 | 115.52 | 22.40 |
| B 7576E | | 1000 | 112.64 | 22.80 |
| B 82E | | 1000 | 110.08 | 22.72 |
| | | Average | 112.75 | 22.64 |

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| B 22C | Room | -- | 317.60 | 279.20 |
| B 26C | | -- | 315.20 | 264.80 |
| B 86C | | -- | 317.55 | 270.20 |
| | | Average | 316.78 | 271.40 |
| B 93C | 400 | 0.5 | 296.80 | 254.40 |
| B 62C | | 0.5 | 300.00 | 249.60 |
| B 14C | | 0.5 | 294.40 | 258.40 |
| | | Average | 297.06 | 254.13 |
| B 21C | | 10 | 289.60 | 252.00 |
| B 76C | | 10 | 296.00 | 255.60 |
| B 56C | | 10 | 295.20 | 248.00 |
| | | Average | 293.60 | 251.86 |
| B 65C | | 100 | 292.00 | 250.40 |
| B 25C | | 100 | 288.80 | 243.20 |
| B 94C | | 100 | 296.80 | 256.00 |
| | | Average | 292.53 | 249.86 |
| B 53C | | 1000 | 288.80 | 248.80 |
| B 51C | | 1000 | 297.60 | 256.00 |
| B 61C | | 1000 | 294.40 | 252.80 |
| | | Average | 293.60 | 252.53 |

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| B 54C | 600 | 0.5 | 291.20 | 250.80 |
| B 11C | | 0.5 | 283.20 | 241.60 |
| B 82C | | 0.5 | 287.20 | 246.40 |
| | | Average | 287.20 | 246.26 |
| B 96C | | 10 | 277.60 | 243.20 |
| B 55C | | 10 | 283.20 | 236.00 |
| B 73C | | 10 | 288.00 | 249.60 |
| | | Average | 282.93 | 242.93 |
| B 81C | | 100 | 280.00 | 240.00 |
| B 13C | | 100 | 276.80 | 237.60 |
| B 43C | | 100 | 279.20 | 243.20 |
| | | Average | 278.66 | 240.26 |
| B 32C | | 1000 | 290.40 | 249.60 |
| B 75C | | 1000 | 288.00 | 247.20 |
| B 44C | | 1000 | 285.60 | 245.20 |
| | | Average | 288.00 | 247.33 |
| B 36C | 800 | 0.5 | 247.20 | 216.80 |
| B 64C | | 0.5 | 244.80 | 214.40 |
| B 12C | | 0.5 | 250.40 | 219.60 |
| | | Average | 247.46 | 216.93 |
| B 15C | | 10 | 243.20 | 220.00 |
| B 63C | | 10 | 240.80 | 215.60 |
| B 95C | | 10 | 246.40 | 224.80 |
| | | Average | 243.46 | 220.13 |
| B 47C | | 100 | 244.00 | 228.00 |
| B 85C | | 100 | 243.20 | 227.20 |
| B 16C | | 100 | 245.60 | 231.20 |
| | | Average | 244.26 | 228.80 |
| B 33C | | 1000 | 270.40 | 236.00 |
| B 52C | | 1000 | 264.80 | 232.00 |
| B 35C | | 1000 | 275.20 | 242.00 |
| | | Average | 270.13 | 236.66 |

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| B 71C | 1000 | 0.5 | 169.60 | 158.40 |
| B 92C | | 0.5 | 170.40 | 156.40 |
| B 45C | | 0.5 | 171.20 | 157.60 |
| | | Average | 170.40 | 157.46 |
| B 53C | | 10 | 165.60 | 150.40 |
| B 23C | | 10 | 165.60 | 148.80 |
| B 72C | | 10 | 165.20 | 151.20 |
| | | Average | 165.47 | 150.13 |
| B 56C | | 100 | 163.20 | 148.80 |
| B 31C | | 100 | 160.00 | 148.80 |
| B 74C | | 100 | 164.00 | 148.00 |
| | | Average | 162.40 | 148.53 |
| B 42C | | 1000 | 141.60 | 118.80 |
| B 46C | | 1000 | 140.00 | 120.00 |
| B 91C | | 1000 | 140.80 | 119.20 |
| | | Average | 140.80 | 119.33 |

TABLE 12. BEARING PROPERTIES OF PH15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| B 43D | Room | -- | 400.80 | 322.40 |
| B 46D | | -- | 400.00 | 328.00 |
| B 34D | | -- | 398.40 | 320.00 |
| | | Average | 399.73 | 323.47 |
| B 25D | 400 | 0.5 | 382.40 | 300.00 |
| B 64D | | 0.5 | 378.40 | 296.00 |
| B 142D | | 0.5 | 386.40 | 303.60 |
| | | Average | 382.40 | 299.87 |
| B 31D | | 10 | 377.60 | 296.80 |
| B 63D | | 10 | 382.40 | 300.40 |
| B 14D | | 10 | 380.00 | 298.40 |
| | | Average | 380.00 | 298.53 |
| B 11D | | 100 | 378.40 | 296.00 |
| B 93D | | 100 | 377.60 | 296.80 |
| B 65D | | 100 | 380.80 | 299.20 |
| | | Average | 378.93 | 297.33 |
| B 84D | | 1000 | 383.20 | 291.20 |
| B 82D | | 1000 | 378.40 | 294.40 |
| B 141D | | 1000 | 372.80 | 296.80 |
| | | Average | 378.13 | 294.13 |

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| B 32D | 600 | 0.5 | 364.80 | 291.20 |
| B 62D | | 0.5 | 363.20 | 288.80 |
| B 95D | | 0.5 | 367.20 | 294.40 |
| | | Average | 365.07 | 291.47 |
| B 96D | | 10 | 360.80 | 288.00 |
| B 41D | | 10 | 366.00 | 290.40 |
| B 33D | | 10 | 363.20 | 288.80 |
| | | Average | 363.33 | 289.07 |
| B 15D | | 100 | 360.80 | 286.40 |
| B 86D | | 100 | 364.00 | 288.00 |
| B 54D | | 100 | 368.00 | 288.00 |
| | | Average | 364.27 | 287.47 |
| B 21D | | 1000 | 369.60 | 292.80 |
| B 16D | | 1000 | 367.20 | 296.00 |
| B 73D | | 1000 | 372.40 | 289.60 |
| | | Average | 369.73 | 292.80 |
| B 83D | 800 | 0.5 | 335.20 | 262.40 |
| B 146D | | 0.5 | 328.00 | 259.20 |
| B 144D | | 0.5 | 342.00 | 264.80 |
| | | Average | 335.07 | 262.13 |
| B 26D | | 10 | 328.00 | 260.00 |
| B 72D | | 10 | 330.40 | 262.40 |
| B 143D | | 10 | 333.20 | 264.00 |
| | | Average | 330.53 | 262.13 |
| B 51D | | 100 | 334.40 | 270.40 |
| B 94D | | 100 | 333.60 | 272.00 |
| B 24D | | 100 | 336.00 | 271.20 |
| | | Average | 334.67 | 271.20 |
| B 61D | | 1000 | 347.20 | 285.60 |
| B 13D | | 1000 | 344.00 | 283.20 |
| B 12D | | 1000 | 348.80 | 280.80 |
| | | Average | 346.67 | 283.20 |

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| B 22D | 1000 | 0.5 | 220.00 | 190.40 |
| B 76D | | 0.5 | 221.60 | 187.20 |
| B 44D | | 0.5 | 220.00 | 194.40 |
| | | Average | 220.53 | 190.67 |
| B 21D | | 10 | 215.20 | 185.60 |
| B 75D | | 10 | 211.20 | 184.00 |
| B 52D | | 10 | 219.60 | 188.80 |
| | | Average | 215.33 | 186.13 |
| B 45D | | 100 | 211.20 | 182.40 |
| B 71D | | 100 | 210.40 | 184.00 |
| B 23D | | 100 | 211.20 | 184.00 |
| | | Average | 210.93 | 183.47 |
| B 55D | | 1000 | 190.40 | 151.20 |
| B 91D | | 1000 | 192.00 | 151.20 |
| B 66D | | 1000 | 188.00 | 150.40 |
| | | Average | 190.13 | 150.93 |

TABLE 13. SHEAR PROPERTIES OF PH15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| B 43F | Room | -- | 144.89 |
| B 7F | | -- | 147.34 |
| B 9F | | -- | 146.14 |
| | | Average | 146.12 |
| B 37F | 400 | 0.5 | 113.47 |
| B 30F | | 0.5 | 115.32 |
| B 28F | | 0.5 | 112.27 |
| | | Average | 113.69 |
| B 49F | | 10 | 115.32 |
| B 31F | | 10 | 113.07 |
| B 32F | | 10 | 119.80 |
| | | Average | 116.06 |
| B 36F | | 100 | 115.07 |
| B 34F | | 100 | 113.07 |
| B 53F | | 100 | 114.91 |
| | | Average | 114.35 |
| B 35F | | 1000 | 119.92 |
| B 33F | | 1000 | 117.89 |
| B 26F | | 1000 | 118.70 |
| | | Average | 118.84 |

TABLE 13. SHEAR PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| B 17F | 600 | 0.5 | 109.06 |
| B 39F | | 0.5 | 109.06 |
| B 52F | | 0.5 | 105.95 |
| | | Average | 108.02 |
| B 29F | | 10 | 108.39 |
| B 8F | | 10 | 105.45 |
| B 38F | | 10 | 106.76 |
| | | Average | 106.86 |
| B 11F | | 100 | 107.86 |
| B 51F | | 100 | 106.36 |
| B 43F | | 100 | 107.58 |
| | | Average | 107.27 |
| B 6F | | 1000 | 113.82 |
| B 2F | | 1000 | 116.67 |
| B 15F | | 1000 | 115.24 |
| | | Average | 115.24 |
| B 90F | 800 | 0.5 | 101.63 |
| B 55F | | 0.5 | 100.64 |
| B 40F | | 0.5 | 101.87 |
| | | Average | 101.38 |
| B 44F | | 10 | 101.42 |
| B 13F | | 10 | 100.81 |
| B 20F | | 10 | 100.81 |
| | | Average | 101.01 |
| B 54F | | 100 | 109.76 |
| B 23F | | 100 | 103.25 |
| B 19F | | 100 | 106.50 |
| | | Average | 106.50 |
| B 4F | | 1000 | 115.04 |
| B 41F | | 1000 | 115.45 |
| B 21F | | 1000 | 115.04 |
| | | Average | 115.18 |

TABLE 13. SHEAR PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Time Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| B 45F | 1000 | 0.5 | 71.60 |
| B 22F | | 0.5 | 74.00 |
| B 14F | | 0.5 | 72.76 |
| | | Average | 72.79 |
| B 25F | | 10 | 74.40 |
| B 5F | | 10 | 64.23 |
| B 47F | | 10 | 69.92 |
| | | Average | 69.52 |
| B 3F | | 100 | 66.26 |
| B 18F | | 100 | 67.07 |
| B 10F | | 100 | 66.66 |
| | | Average | 66.67 |
| B 21F | | 1000 | 60.98 |
| B 42F | | 1000 | 61.79 |
| B 1F | | 1000 | 60.16 |
| | | Average | 60.98 |

TABLE 14. TENSILE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| E 56A | Room | -- | 219.54 | 183.50 | 29.28 | 13.9 | C 46.0 |
| E 82A | | -- | 220.30 | 184.61 | 30.23 | 13.3 | C 46.5 |
| E 12A(T)* | | -- | 220.00 | 183.60 | 29.51 | 13.2 | C 46.5 |
| | | Average | 219.95 | 183.90 | 29.67 | 13.4 | C 46.3 |
| E 81A | 400 | 0.5 | 209.16 | 161.35 | 26.25 | 9.9 | C 40.0 |
| E 53A | | 0.5 | 211.87 | 160.91 | 26.65 | 10.2 | C 41.0 |
| E 105A | | 0.5 | 210.72 | 162.83 | 27.33 | 10.0 | C 40.0 |
| | | Average | 210.58 | 161.70 | 26.74 | 10.0 | C 40.6 |
| E 63A | | 10 | 205.36 | 156.32 | 26.99 | 8.3 | C 38.0 |
| E 114A | | 10 | 210.34 | 160.92 | 26.54 | 8.3 | C 38.0 |
| E 43A | | 10 | 202.68 | 157.08 | 26.57 | 8.2 | C 39.0 |
| | | Average | 206.13 | 158.11 | 26.70 | 8.3 | C 38.3 |
| E 73A | | 100 | 201.92 | 152.11 | 26.19 | 8.2 | C 36.0 |
| E 46A | | 100 | 199.23 | 150.19 | 26.49 | 8.0 | C 37.0 |
| E 112A | | 100 | 205.36 | 153.20 | 26.53 | 8.2 | C 36.0 |
| | | Average | 202.17 | 151.83 | 26.40 | 8.1 | C 36.3 |
| E 41A | | 1000 | 198.47 | 142.15 | 26.51 | 8.8 | C 35.0 |
| E 15A | | 1000 | 199.62 | 143.68 | 26.26 | 8.4 | C 36.0 |
| E 22A | | 1000 | 199.62 | 142.15 | 26.35 | 9.0 | C 35.0 |
| | | Average | 199.24 | 142.66 | 26.37 | 8.7 | C 35.3 |

*Tuckerman Optical Strain Gage

TABLE 14. TENSILE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| E 34A | 600 | 0.5 | 206.51 | 155.94 | 26.20 | 8.6 | C 40.0 |
| E 78A | | 0.5 | 201.92 | 156.32 | 25.93 | 8.8 | C 39 0 |
| E 113A | | 0.5 | 204.98 | 155.56 | 25.67 | 8.7 | C 39.0 |
| | | Average | 204.47 | 155.94 | 25.93 | 8.7 | C 39.3 |
| E 101A | | 10 | 201.15 | 153.26 | 25.44 | 7.3 | C 39.0 |
| E 123A | | 10 | 201.53 | 155.17 | 25.07 | 7.2 | C 38.0 |
| E 31A | | 10 | 203.06 | 154.02 | 25.67 | 6.9 | C 37.5 |
| | | Average | 201.91 | 154.15 | 25.39 | 7.1 | C 33.1 |
| E 86A | | 100 | 203.45 | 153.64 | 25.82 | 6.2 | C 33.0 |
| E 61A | | 100 | 204.21 | 167.04 | 25.10 | 6.4 | C 39.0 |
| E 26A | | 100 | 204.60 | 160.15 | 25.67 | 6.0 | C 39.0 |
| | | Average | 204.09 | 160.28 | 25.53 | 6.2 | C 38.3 |
| E 105A | | 1000 | 205.75 | 158.24 | 25.86 | 7.9 | C 37.0 |
| E 24A | | 1000 | 207.66 | 158.50 | 25.86 | 7.1 | C 38.0 |
| E 72A | | 1000 | 206.71 | 158.24 | 25.48 | 7.5 | C 38.0 |
| | | Average | 206.71 | 158.33 | 25.73 | 7.5 | C 37.6 |

TABLE 14. TENSILE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi × $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| E 25A | 800 | 0.5 | 180.00 | 133.60 | 24.47 | 7.6 | C 38.0 |
| E 76A | | 0.5 | 182.80 | 132.80 | 24.78 | 7.9 | C 38.5 |
| E 104A | | 0.5 | 183.59 | 133.33 | 24.60 | 7.9 | C 38.0 |
| | | Average | 182.13 | 133.24 | 24.62 | 7.8 | C 38.[illegible] |
| E 83A | | 10 | 186.16 | 137.16 | 24.33 | 7.8 | C 37.0 |
| E 23A | | 10 | 185.82 | 136.02 | 24.43 | 7.6 | C 38.0 |
| E 124A | | 10 | 186.97 | 137.93 | 24.33 | 7.7 | C 38.0 |
| | | Average | 186.32 | 137.04 | 24.33 | 7.7 | C 37.6 |
| E 51A | | 100 | 193.48 | 141.38 | 24.52 | 6.2 | C 38.5 |
| E 32A | | 100 | 190.42 | 140.23 | 24.52 | 6.4 | C 39.0 |
| E 91A | | 100 | 190.80 | 139.85 | 24.71 | 6.3 | C 39.0 |
| | | Average | 191.57 | 140.49 | 24.58 | 6.3 | C 38.3 |
| E 65A | | 1000 | 205.40 | 144.40 | 24.81 | 7.1 | C 41.0 |
| E 52A | | 1000 | 202.30 | 143.90 | 24.91 | 7.5 | C 41.0 |
| E 103A | | 1000 | 203.45 | 144.83 | 25.09 | 7.5 | C 40.5 |
| | | Average | 203.72 | 144.38 | 24.94 | 7.4 | C 40.8 |

TABLE 14. TENSILE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| E 106A | 1000 | 0.5 | 125.96 | 98.08 | 20.96 | 12.5 | C 35.0 |
| E 112A | | 0.5 | 123.08 | 99.62 | 20.87 | 12.6 | C 34.0 |
| E 23A | | 0.5 | 126.92 | 97.69 | 20.88 | 11.6 | C 33.5 |
| | | Average | 125.32 | 98.46 | 20.90 | 12.2 | C 34.1 |
| E 101A | | 10 | 131.03 | 111.10 | 22.03 | 15.1 | C 31.0 |
| E 33A | | 10 | 132.57 | 108.43 | 22.32 | 14.1 | C 29.5 |
| E 55A | | 10 | 134.10 | 109.19 | 22.22 | 14.3 | C 23.5 |
| | | Average | 132.57 | 109.57 | 22.19 | 14.5 | C 29.6 |
| E 62A | | 100 | 116.98 | 94.34 | 20.38 | 16.3 | C 26.0 |
| E 74A | | 100 | 117.69 | 97.69 | 20.77 | 16.8 | C 26.5 |
| E 95A | | 100 | 116.86 | 92.72 | 20.50 | 15.8 | C 24.5 |
| | | Average | 117.18 | 94.92 | 20.55 | 16.3 | C 25.6 |
| E 94A | | 1000 | 109.58 | 88.89 | 20.11 | 19.1 | C 20.5 |
| E 96A | | 1000 | 105.66 | 85.28 | 20.31 | 20.4 | C 21.0 |
| E 85A | | 1000 | 109.20 | 90.04 | 20.11 | 18.4 | C 20.0 |
| | | Average | 108.15 | 88.07 | 20.18 | 19.3 | C 20.5 |

TABLE 15. NOTCHED TENSILE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| E 47B | Room | -- | 248.27 | |
| E 55B | | -- | 256.70 | |
| E 94B | | -- | 247.10 | |
| | | Average | 250.69 | 1.140 |
| E 101B | 400 | 0.5 | 223.85 | |
| E 44B | | 0.5 | 220.99 | |
| E 67B | | 0.5 | 228.02 | |
| | | Average | 224.29 | 1.065 |
| E 88B | | 10 | 219.23 | |
| E 27B | | 10 | 220.62 | |
| E 123B | | 10 | 223.92 | |
| | | Average | 221.26 | 1.073 |
| E 31B | | 100 | 223.83 | |
| E 121B | | 100 | 228.79 | |
| E 57B | | 100 | 229.57 | |
| | | Average | 227.40 | 1.125 |
| E 93B | | 1000 | 226.80 | |
| E 17B | | 1000 | 225.67 | |
| E 86B | | 1000 | 223.75 | |
| | | Average | 225.41 | 1.131 |

TABLE 15. NOTCHED TENSILE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| E 28B | 600 | 0.5 | 215.70 | |
| E 32B | | 0.5 | 238.70 | |
| E 114B | | 0.5 | 219.16 | |
| | | Average | 224.19 | 1.096 |
| E 61B | | 10 | 222.60 | |
| E 37B | | 10 | 220.30 | |
| E 108B | | 10 | 221.15 | |
| | | Average | 221.35 | 1.051 |
| E 92B | | 100 | 220.30 | |
| E 56B | | 100 | 223.76 | |
| E 14B | | 100 | 224.90 | |
| | | Average | 222.99 | 1.093 |
| E 72B | | 1000 | 229.12 | |
| E 65B | | 1000 | 227.20 | |
| E 121B | | 1000 | 228.00 | |
| | | Average | 228.11 | 1.104 |
| E 22B | 800 | 0.5 | 203.83 | |
| E 78B | | 0.5 | 205.35 | |
| E 124B | | 0.5 | 203.83 | |
| | | Average | 204.33 | 1.122 |
| E 91B | | 10 | 206.13 | |
| E 107B | | 10 | 205.10 | |
| E 12B | | 10 | 206.15 | |
| | | Average | 215.79 | 1.158 |
| E 38B | | 100 | 209.06 | |
| E 71B | | 100 | 208.08 | |
| E 111B | | 100 | 208.05 | |
| | | Average | 208.40 | 1.088 |
| E 48B | | 1000 | 211.34 | |
| E 98B | | 1000 | 213.23 | |
| E 62B | | 1000 | 215.00 | |
| | | Average | 213.19 | 1.046 |

TABLE 15. NOTCHED TENSILE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| E 14B | 1000 | 0.5 | 135.60 | |
| E 103B | | 0.5 | 132.20 | |
| E 96B | | 0.5 | 136.02 | |
| | | Average | 134.61 | 1.074 |
| E 51B | | 10 | 166.28 | |
| E 106B | | 10 | 166.70 | |
| E 85B | | 10 | 167.43 | |
| | | Average | 166.80 | 1.258 |
| E 26B | | 100 | 124.50 | |
| E 84B | | 100 | 123.40 | |
| E 66B | | 100 | 126.04 | |
| | | Average | 124.65 | 1.064 |
| E 77B | | 1000 | 105.40 | |
| E 122B | | 1000 | 111.70 | |
| E 63B | | 1000 | 110.15 | |
| | | Average | 109.08 | 1.009 |

TABLE 16. RUPTURE STRENGTHS OF AM 355 BASED ON BOTH ORIGINAL AND FINAL AREAS

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| E 56A | Room | -- | 183.91 | 281.36 |
| E 82A | | -- | 186.47 | 261.74 |
| E 12A | | -- | 194.12 | 267.57 |
| | | Average | 188.16 | 270.22 |
| E 81A | 400 | 0.5 | 193.63 | 245.08 |
| E 53A | | 0.5 | 194.64 | 249.02 |
| E 105A | | 0.5 | 194.64 | 246.00 |
| | | Average | 194.30 | 246.70 |
| E 63A | | 10 | 185.82 | 263.44 |
| E 114A | | 10 | 190.80 | 267.02 |
| E 43A | | 10 | 181.92 | 259.18 |
| | | Average | 186.18 | 263.21 |
| E 73A | | 100 | 183.91 | 247.42 |
| E 46A | | 100 | 183.91 | 253.97 |
| E 112A | | 100 | 176.25 | 256.41 |
| | | Average | 181.35 | 252.60 |
| E 41A | | 1000 | 174.33 | 220.77 |
| E 15A | | 1000 | 179.12 | 236.11 |
| E 22A | | 1000 | 174.33 | 224.69 |
| | | Average | 175.92 | 227.19 |

TABLE 16. RUPTURE STRENGTHS OF AM 355 BASED ON BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| E 34A | 600 | 0.5 | 176.25 | 207.86 |
| E 78A | | 0.5 | 178.93 | 229.60 |
| E 113A | | 0.5 | 181.99 | 219.20 |
| | | Average | 179.05 | 218.88 |
| E 101A | | 10 | 193.49 | 235.76 |
| E 123A | | 10 | 191.57 | 260.42 |
| E 31A | | 10 | 191.57 | 243.31 |
| | | Average | 192.21 | 246.49 |
| E 86A | | 100 | 183.91 | 232.33 |
| E 61A | | 100 | 183.91 | 232.33 |
| E 26A | | 100 | 185.82 | 235.32 |
| | | Average | 184.54 | 233.32 |
| E 105A | | 1000 | 193.49 | 279.78 |
| E 24A | | 1000 | 201.15 | 229.26 |
| E 72A | | 1000 | 197.70 | 201.11 |
| | | Average | 197.45 | 236.35 |
| E 25A | 800 | 0.5 | 153.60 | 196.92 |
| E 76A | | 0.5 | 169.14 | 222.62 |
| E 104A | | 0.5 | 169.92 | 223.65 |
| | | Average | 164.22 | 214.39 |
| E 83A | | 10 | 170.50 | 219.86 |
| E 23A | | 10 | 167.82 | 216.83 |
| E 124A | | 10 | 169.35 | 218.38 |
| | | Average | 169.22 | 218.35 |
| E 51A | | 100 | 149.43 | 207.89 |
| E 32A | | 100 | 157.85 | 198.55 |
| E 91A | | 100 | 170.11 | 233.68 |
| | | Average | 159.13 | 213.37 |
| E 65A | | 1000 | 186.21 | 212.41 |
| E 52A | | 1000 | 187.74 | 229.08 |
| E 103A | | 1000 | 184.29 | 210.69 |
| | | Average | 186.08 | 217.39 |

TABLE 16. RUPTURE STRENGTHS OF AM 355 BASED ON BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| E 106A | 1000 | 0.5 | 67.31 | 115.97 |
| E 112A | | 0.5 | 66.15 | 112.20 |
| E 23A | | 0.5 | 67.43 | 115.11 |
| | | Average | 66.96 | 114.42 |
| E 101A | | 10 | 67.05 | 108.02 |
| E 33A | | 10 | 68.20 | 149.33 |
| E 55A | | 10 | 65.90 | 132.31 |
| | | Average | 67.05 | 129.55 |
| E 62A | | 100 | 63.77 | 142.26 |
| E 74A | | 100 | 65.38 | 147.06 |
| E 95A | | 100 | 64.37 | 135.48 |
| | | Average | 64.50 | 141.60 |
| E 94A | | 1000 | 65.52 | 119.08 |
| E 96A | | 1000 | 63.40 | 99.23 |
| E 85A | | 1000 | 62.45 | 128.35 |
| | | Average | 63.79 | 115.55 |

TABLE 17. COMPRESSIVE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi $\times 10^{-6}$) |
|---|---|---|---|---|
| E 51E | Room | -- | 216.18 | 30.25 |
| E 76E | | -- | 216.56 | 29.51 |
| E 43E | | -- | 218.16 | 30.25 |
| | | Average | 216.79 | 30.00 |
| E 101E | 400 | 0.5 | 176.92 | 28.15 |
| E 614E | | 0.5 | 180.92 | 28.31 |
| E 114E | | 0.5 | 184.31 | 28.46 |
| | | Average | 180.72 | 28.31 |
| E 312E | | 10 | 180.00 | 28.46 |
| E 35E | | 10 | 181.54 | 27.69 |
| E 124E | | 10 | 186.77 | 28.00 |
| | | Average | 182.77 | 28.05 |
| E 104E | | 100 | 182.46 | 27.54 |
| E 82E | | 100 | 180.00 | 28.77 |
| E 23E | | 100 | 186.15 | 28.77 |
| | | Average | 182.87 | 28.36 |
| E 512E | | 1000 | 183.08 | 28.15 |
| E 32E | | 1000 | 185.85 | 28.92 |
| E 113E | | 1000 | 195.08 | 28.92 |
| | | Average | 188.00 | 28.66 |

TABLE 17. COMPRESSIVE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi $\times 10^{-6}$) |
|---|---|---|---|---|
| E 834E | 600 | 0.5 | 179.38 | 26.92 |
| E 134E | | 0.5 | 174.15 | 26.92 |
| E 65E | | 0.5 | 172.00 | 27.07 |
| | | Average | 175.18 | 26.97 |
| E 412E | | 10 | 172.31 | 26.92 |
| E 22E | | 10 | 172.31 | 26.92 |
| E 81E | | 10 | 173.85 | 26.77 |
| | | Average | 172.82 | 26.87 |
| E 21E | | 100 | 169.54 | 26.15 |
| E 334E | | 100 | 177.57 | 26.92 |
| E 1134E | | 100 | 173.54 | 26.92 |
| | | Average | 173.55 | 26.66 |
| E 434E | | 1000 | 176.92 | 26.92 |
| E 25E | | 1000 | 174.77 | 27.07 |
| E 111E | | 1000 | 184.62 | 27.07 |
| | | Average | 178.77 | 27.02 |
| E 456E | 800 | 0.5 | 164.92 | 26.15 |
| E 123E | | 0.5 | 163.08 | 26.15 |
| E 62E | | 0.5 | 170.77 | 26.15 |
| | | Average | 166.25 | 26.15 |
| E 12E | | 10 | 166.46 | 26.15 |
| E 93E | | 10 | 173.23 | 26.15 |
| E 612E | | 10 | 167.08 | 26.31 |
| | | Average | 168.92 | 26.20 |
| E 55E | | 100 | 175.38 | 27.08 |
| E 24E | | 100 | 169.85 | 25.69 |
| E 102E | | 100 | 169.23 | 26.31 |
| | | Average | 171.49 | 26.36 |
| E 33E | | 1000 | 190.15 | 28.62 |
| E 1056E | | 1000 | 195.38 | 28.62 |
| E 356E | | 1000 | 193.38 | 27.69 |
| | | Average | 192.97 | 28.31 |

TABLE 17. COMPRESSIVE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi X $10^{-6}$) |
|---|---|---|---|---|
| E 754E | 1000 | 0.5 | 125.54 | 21.54 |
| E 812E | | 0.5 | 128.31 | 22.31 |
| E 61E | | 0.5 | 131.08 | 21.69 |
| | | Average | 128.31 | 21.85 |
| E 14E | | 10 | 116.92 | 21.54 |
| E 1112E | | 10 | 120.92 | 21.15 |
| E 86E | | 10 | 111.08 | 21.69 |
| | | Average | 116.31 | 21.46 |
| E 96E | | 100 | 108.31 | 21.54 |
| E 16E | | 100 | 103.38 | 21.54 |
| E 1012E | | 100 | 100.00 | 21.38 |
| | | Average | 103.90 | 21.49 |
| E 41E | | 1000 | 89.85 | 19.85 |
| E 556E | | 1000 | 92.31 | 19.85 |
| E 112E | | 1000 | 93.23 | 19.69 |
| | | Average | 91.80 | 19.80 |

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| E 124C | Room | -- | 384.40 | 320.00 |
| E 106C | | -- | 385.60 | 320.00 |
| E 15C | | -- | 388.80 | 325.60 |
| | | Average | 386.27 | 321.87 |
| E 63C | 400 | 0.5 | 354.40 | 303.20 |
| E 94C | | 0.5 | 353.20 | 295.20 |
| E 24C | | 0.5 | 356.00 | 300.80 |
| | | Average | 354.53 | 299.73 |
| E 62C | | 10 | 348.80 | 292.80 |
| E 23C | | 10 | 352.00 | 295.20 |
| E 114C | | 10 | 355.20 | 296.00 |
| | | Average | 352.00 | 294.67 |
| E 76C | | 100 | 356.00 | 288.00 |
| E 94C | | 100 | 351.20 | 291.20 |
| E 33C | | 100 | 347.60 | 295.20 |
| | | Average | 351.60 | 291.47 |
| E 13C | | 1000 | 350.40 | 291.20 |
| E 121C | | 1000 | 346.40 | 294.40 |
| E 61C | | 1000 | 353.60 | 290.40 |
| | | Average | 350.13 | 292.00 |

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| E 53C | 600 | 0.5 | 346.40 | 288.00 |
| E 96C | | 0.5 | 351.20 | 292.80 |
| E 32C | | 0.5 | 343.20 | 284.00 |
| | | **Average** | 346.93 | 288.27 |
| E 64C | | 10 | 345.60 | 286.40 |
| E 31C | | 10 | 340.00 | 284.00 |
| E 25C | | 10 | 342.80 | 284.80 |
| | | **Average** | 342.80 | 285.07 |
| E 35C | | 100 | 349.60 | 289.60 |
| E 72C | | 100 | 344.00 | 284.80 |
| E 85C | | 100 | 342.40 | 280.80 |
| | | **Average** | 345.33 | 285.07 |
| E 43C | | 1000 | 347.20 | 286.40 |
| E 84C | | 1000 | 348.80 | 287.20 |
| E 123C | | 1000 | 346.40 | 285.60 |
| | | **Average** | 347.47 | 286.40 |
| E 34C | 800 | 0.5 | 320.00 | 270.40 |
| E 112C | | 0.5 | 320.80 | 270.40 |
| E 104C | | 0.5 | 320.00 | 270.40 |
| | | **Average** | 320.27 | 270.40 |
| E 101C | | 10 | 321.60 | 268.88 |
| E 45C | | 10 | 320.80 | 272.00 |
| E 71C | | 10 | 322.80 | 272.00 |
| | | **Average** | 321.73 | 270.93 |
| E 14C | | 100 | 328.00 | 275.20 |
| E 73C | | 100 | 323.20 | 271.20 |
| E 52C | | 100 | 320.40 | 268.00 |
| | | **Average** | 323.87 | 271.47 |
| E 105C | | 1000 | 324.80 | 272.00 |
| E 65C | | 1000 | 328.80 | 275.20 |
| E 36C | | 1000 | 320.00 | 269.60 |
| | | **Average** | 324.53 | 272.27 |

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| E 102C | 1000 | 0.5 | 232.80 | 203.20 |
| E 44C | | 0.5 | 231.20 | 205.60 |
| E 11C | | 0.5 | 230.40 | 199.20 |
| | | Average | 231.47 | 202.67 |
| E 83C | | 10 | 184.80 | 165.60 |
| E 26C | | 10 | 184.00 | 164.40 |
| E 66C | | 10 | 188.00 | 168.00 |
| | | Average | 185.60 | 166.00 |
| E 63C | | 100 | 172.00 | 147.20 |
| E 12C | | 100 | 168.80 | 147.20 |
| E 103C | | 100 | 175.20 | 150.40 |
| | | Average | 172.00 | 148.27 |
| E 82C | | 1000 | 167.20 | 140.00 |
| E 111C | | 1000 | 166.40 | 140.00 |
| E 16C | | 1000 | 168.00 | 141.60 |
| | | Average | 167.20 | 140.53 |

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| E 86D | Room | -- | 496.00 | 400.00 |
| E 103D | | -- | 499.20 | 400.00 |
| E 53D | | -- | 500.80 | 400.80 |
| | | Average | 498.67 | 400.27 |
| E 122D | 400 | 0.5 | 460.00 | 368.00 |
| E 41D | | 0.5 | 462.40 | 372.80 |
| E 65D | | 0.5 | 452.80 | 364.00 |
| | | Average | 458.40 | 368.27 |
| E 95D | | 10 | 450.40 | 361.60 |
| E 21D | | 10 | 454.40 | 364.00 |
| E 46D | | 10 | 457.60 | 367.20 |
| | | Average | 454.13 | 364.27 |
| E 85D | | 100 | 452.00 | 362.40 |
| E 61D | | 100 | 456.00 | 366.40 |
| E 24D | | 100 | 448.40 | 360.00 |
| | | Average | 452.13 | 362.93 |
| E 93D | | 1000 | 451.20 | 360.00 |
| E 55D | | 1000 | 455.60 | 361.60 |
| E 14D | | 1000 | 447.20 | 359.20 |
| | | Average | 451.33 | 360.27 |

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| E 25D | 600 | 0.5 | 440.40 | 353.60 |
| E 105D | | 0.5 | 432.00 | 351.20 |
| E 72D | | 0.5 | 436.00 | 352.00 |
| | | **Average** | 436.13 | 352.27 |
| E 32D | | 10 | 436.80 | 355.20 |
| E 73D | | 10 | 434.40 | 350.40 |
| E 114D | | 10 | 432.80 | 346.40 |
| | | **Average** | 434.67 | 350.67 |
| E 104D | | 100 | 435.20 | 356.00 |
| E 26D | | 100 | 434.40 | 351.20 |
| E 63D | | 100 | 430.40 | 346.00 |
| | | **Average** | 433.33 | 351.07 |
| E 33D | | 1000 | 436.80 | 354.40 |
| E 102D | | 1000 | 436.00 | 356.80 |
| E 74D | | 1000 | 438.80 | 353.60 |
| | | **Average** | 437.20 | 354.93 |
| E 82D | 800 | 0.5 | 384.00 | 316.80 |
| E 44D | | 0.5 | 388.80 | 319.20 |
| E 12D | | 0.5 | 380.00 | 315.20 |
| | | **Average** | 384.27 | 317.07 |
| E 43D | | 10 | 384.80 | 319.20 |
| E 16D | | 10 | 386.40 | 323.20 |
| E 84D | | 10 | 384.00 | 316.00 |
| | | **Average** | 385.07 | 319.47 |
| E 54D | | 100 | 391.60 | 326.40 |
| E 113D | | 100 | 383.20 | 315.20 |
| E 42D | | 100 | 387.20 | 320.00 |
| | | **Average** | 387.33 | 320.53 |
| E 52D | | 1000 | 391.20 | 330.40 |
| E 15D | | 1000 | 394.40 | 332.80 |
| E 106D | | 1000 | 388.80 | 328.00 |
| | | **Average** | 391.47 | 330.40 |

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| E 124D | 1000 | 0.5 | 290.40 | 236.00 |
| E 86D | | 0.5 | 288.80 | 230.40 |
| E 36D | | 0.5 | 292.80 | 237.60 |
| | | Average | 290.67 | 234.67 |
| E 34D | | 10 | 266.40 | 211.20 |
| E 83D | | 10 | 269.60 | 215.20 |
| E 111D | | 10 | 266.40 | 213.60 |
| | | Average | 267.47 | 213.33 |
| E 121D | | 100 | 226.40 | 184.80 |
| E 66D | | 100 | 224.00 | 180.80 |
| E 23D | | 100 | 228.80 | 184.00 |
| | | Average | 226.40 | 183.20 |
| E 22D | | 1000 | 200.00 | 156.00 |
| E 81D | | 1000 | 203.20 | 162.80 |
| E 76D | | 1000 | 203.20 | 165.60 |
| | | Average | 202.13 | 161.47 |

TABLE 19. SHEAR PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| E 62F | Ambient | -- | 138.43 |
| E 61F | | -- | 135.49 |
| E 60F | | -- | 138.95 |
| | | Average | 137.62 |
| E 1F | 400 | 0.5 | 121.14 |
| E 2F | | 0.5 | 119.08 |
| E 3F | | 0.5 | 123.06 |
| | | Average | 121.09 |
| E 4F | | 10 | 115.88 |
| E 5F | | 10 | 118.70 |
| E 6F | | 10 | 123.98 |
| | | Average | 119.52 |
| E 7F | | 100 | 118.17 |
| E 8F | | 100 | 116.28 |
| E 9F | | 100 | 121.02 |
| | | Average | 118.49 |
| E 46F | | 1000 | 123.78 |
| E 47F | | 1000 | 121.95 |
| E 48F | | 1000 | 122.76 |
| | | Average | 122.83 |

TABLE 19. SHEAR PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| E 19F | 600 | 0.5 | 121.95 |
| E 20F | | 0.5 | 124.79 |
| E 21F | | 0.5 | 123.37 |
| | | Average | 123.37 |
| E 22F | | 10 | 124.79 |
| E 23F | | 10 | 113.01 |
| E 24F | | 10 | 113.41 |
| | | Average | 117.07 |
| E 25F | | 100 | 119.11 |
| E 26F | | 100 | 118.69 |
| E 27F | | 100 | 118.90 |
| | | Average | 118.90 |
| E 29F | | 1000 | 122.36 |
| E 30F | | 1000 | 123.17 |
| E 28F | | 1000 | 122.77 |
| | | Average | 122.77 |
| E 12F | 800 | 0.5 | 111.65 |
| E 11F | | 0.5 | 110.02 |
| E 10F | | 0.5 | 113.28 |
| | | Average | 111.65 |
| E 15F | | 10 | 112.27 |
| E 14F | | 10 | 110.84 |
| E 13F | | 10 | 122.69 |
| | | Average | 115.27 |
| E 17F | | 100 | 112.06 |
| E 16F | | 100 | 110.24 |
| E 18F | | 100 | 110.43 |
| | | Average | 110.91 |
| E 34F | | 1000 | 119.51 |
| E 35F | | 1000 | 118.70 |
| E 36F | | 1000 | 120.33 |
| | | Average | 119.51 |

TABLE 19. SHEAR PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| E 37F | 1000 | 0.5 | 84.15 |
| E 38F | | 0.5 | 74.39 |
| E 39F | | 0.5 | 79.27 |
| | | Average | 79.20 |
| E 42F | | 10 | 66.26 |
| E 40F | | 10 | 66.99 |
| E 41F | | 10 | 66.67 |
| | | Average | 66.64 |
| E 43F | | 100 | 68.29 |
| E 44F | | 100 | 72.76 |
| E 45F | | 100 | 70.53 |
| | | Average | 70.53 |
| E 33F | | 1000 | 69.51 |
| E 32F | | 1000 | 63.01 |
| E 31F | | 1000 | 66.26 |
| | | Average | 66.26 |

## TABLE 20. TENSILE PROPERTIES OF RENE 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi X $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| F 92A | Room | --- | 184.96 | 141.60 | 30.14 | 10.9 | C 44.0 |
| F 22A (T)* | | --- | 186.32 | 142.37 | 29.91 | 10.0 | C 43.0 |
| F 37A | | --- | 183.28 | 141.40 | 29.87 | 10.3 | C 44.0 |
| | | Average | 184.85 | 141.79 | 29.97 | 10.4 | C 43.5 |
| F 41A | 600 | 0.5 | 172.10 | 127.05 | 28.12 | 13.8 | C 43.0 |
| F 103A | | 0.5 | 170.90 | 126.90 | 27.95 | 13.6 | C 43.0 |
| F 73A | | 0.5 | 170.11 | 126.50 | 28.97 | 14.0 | C 43.0 |
| | | Average | 171.03 | 126.82 | 28.05 | 13.8 | C 43.0 |
| F 28A | | 10 | 167.40 | 123.60 | 27.80 | 11.6 | C 41.0 |
| F 116A | | 10 | 167.90 | 121.80 | 27.65 | 11.2 | C 42.0 |
| F 25A | | 10 | 169.73 | 122.99 | 27.39 | 11.8 | C 42.0 |
| | | Average | 168.34 | 122.80 | 27.61 | 11.5 | C 41.6 |
| F 62A | | 100 | 169.35 | 126.44 | 27.90 | 13.3 | C 42.0 |
| F 77A | | 100 | 167.82 | 124.14 | 28.35 | 13.6 | C 42.0 |
| F 96A | | 100 | 168.20 | 124.52 | 27.78 | 13.3 | C 42.0 |
| | | Average | 168.45 | 126.03 | 28.01 | 13.4 | C 42.0 |
| F 26A | | 1000 | 169.35 | 126.44 | 28.11 | 15.2 | C 42.0 |
| F 68A | | 1000 | 171.26 | 126.44 | 28.38 | 16.0 | C 43.0 |
| F 104A | | 1000 | 168.20 | 127.97 | 28.16 | 17.9 | C 42.0 |
| | | Average | 169.60 | 126.95 | 28.22 | 16.4 | C 42.3 |

*Tuckerman Optical Strain Gage

TABLE 20. TENSILE PROPERTIES OF RENE 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi X $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| F 108A | 900 | 0.5 | 164.75 | 122.60 | 26.31 | 16.8 | C 41.0 |
| F 13A | | 0.5 | 165.90 | 124.35 | 26.78 | 16.8 | C 41.0 |
| F 55A | | 0.5 | 163.22 | 123.00 | 26.44 | 16.6 | C 42.0 |
| | | Average | 164.62 | 123.32 | 26.51 | 16.7 | C 41.3 |
| F 115A | | 10 | 154.00 | 119.20 | 26.30 | 17.5 | C 40.0 |
| F 23A | | 10 | 159.96 | 123.19 | 26.44 | 17.6 | C 39.0 |
| F 44A | | 10 | 157.47 | 122.22 | 26.10 | 16.9 | C 40.0 |
| | | Average | 157.14 | 121.54 | 26.28 | 17.3 | C 39.6 |
| F 58A | | 100 | 162.84 | 124.14 | 26.50 | 14.3 | C 41.0 |
| F 128A | | 100 | 160.92 | 124.50 | 25.93 | 14.0 | C 40.0 |
| F 32A | | 100 | 161.72 | 124.35 | 26.24 | 14.0 | C 39.0 |
| | | Average | 161.82 | 124.33 | 26.22 | 14.1 | C 40.0 |
| F 105A | | 1000 | 165.20 | 124.49 | 26.36 | 14.6 | C 41.0 |
| F 61A | | 1000 | 164.50 | 124.50 | 26.10 | 14.1 | C 41.0 |
| F 12A | | 1000 | 162.80 | 125.86 | 26.42 | 14.3 | C 42.0 |
| | | Average | 164.16 | 124.95 | 26.29 | 14.3 | C 41.3 |

TABLE 20. TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| F 15A | 1200 | 0.5 | 160.60 | 122.40 | 25.42 | 7.6 | C 40.0 |
| F 42A | | 0.5 | 160.92 | 122.32 | 26.67 | 7.8 | C 40.0 |
| F 106A | | 0.5 | 160.54 | 123.37 | 25.67 | 7.4 | C 39.0 |
| | | Average | 160.67 | 122.70 | 25.59 | 7.6 | C 39.6 |
| F 47A | | 10 | 155.17 | 121.07 | 25.15 | 5.2 | C 34.0 |
| F 118A | | 10 | 155.56 | 121.84 | 25.67 | 5.2 | C 35.0 |
| F 11A | | 10 | 156.70 | 121.65 | 24.90 | 5.4 | C 35.0 |
| | | Average | 155.81 | 121.52 | 25.24 | 5.3 | C 34.6 |
| F 48A | | 100 | 161.30 | 121.46 | 25.10 | 6.2 | C 38.0 |
| F 24A | | 100 | 161.69 | 121.84 | 25.25 | 6.3 | C 36.0 |
| F 85A | | 100 | 161.30 | 122.61 | 25.86 | 6.2 | C 38.0 |
| | | Average | 161.43 | 121.97 | 25.40 | 6.2 | C 37.3 |
| F 27A | | 1000 | 162.07 | 122.03 | 25.25 | 7.6 | C 36.0 |
| F 78A | | 1000 | 161.69 | 122.61 | 25.82 | 7.0 | C 38.0 |
| F 107A | | 1000 | 161.88 | 121.46 | 25.86 | 6.3 | C 37.0 |
| | | Average | 161.88 | 122.03 | 25.98 | 7.0 | C 37.0 |

TABLE 20. TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi × $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| F 74A | 1400 | 0.5 | 145.21 | 114.94 | 19.54 | 5.3 | C 31.0 |
| F 66A | | 0.5 | 145.59 | 116.86 | 19.73 | 5.1 | C 31.0 |
| F 121A | | 0.5 | 145.02 | 116.09 | 19.73 | 5.5 | C 33.0 |
| | | Average | 145.27 | 115.96 | 19.67 | 5.3 | C 31.6 |
| F 54A | | 10 | 142.15 | 112.64 | 19.54 | 5.4 | C 24.0 |
| F 102A | | 10 | 143.68 | 113.03 | 19.73 | 5.0 | C 25.0 |
| F 75A | | 10 | 143.30 | 111.11 | 19.92 | 5.5 | C 24.0 |
| | | Average | 143.04 | 112.26 | 19.73 | 5.3 | C 24.3 |
| F 56A | | 100 | 141.38 | 109.20 | 19.92 | 7.0 | C 21.0 |
| F 123A | | 100 | 143.15 | 111.49 | 19.54 | 8.2 | C 24.0 |
| F 81A | | 100 | 141.76 | 110.34 | 19.92 | 7.3 | C 22.0 |
| | | Average | 141.76 | 110.34 | 19.79 | 7.5 | C 22.3 |
| F 94A | | 1000 | 132.18 | 98.47 | 19.92 | 8.3 | C 18.0 |
| F 126A | | 1000 | 131.80 | 97.70 | 19.64 | 8.7 | C 17.0 |
| F 51A | | 1000 | 130.27 | 96.93 | 19.16 | 8.9 | C 19.0 |
| | | Average | 131.41 | 97.70 | 19.57 | 8.6 | C 18.0 |

TABLE 20. TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| F 57A | 1500 | 0.5 | 127.97 | 105.75 | 18.77 | 4.4 | A 82.0 |
| F 31A | | 0.5 | 126.44 | 103.83 | 18.77 | 4.0 | A 80.0 |
| F 112A | | 0.5 | 129.50 | 106.90 | 18.97 | 4.2 | A 81.0 |
| | | Average | 127.97 | 105.49 | 18.84 | 4.2 | A 81.0 |
| F 45A | | 10 | 124.52 | 100.38 | 18.58 | 6.3 | A 75.0 |
| F 21A | | 10 | 126.67 | 98.08 | 18.39 | 6.4 | A 76.0 |
| F 33A | | 10 | 122.99 | 100.00 | 18.39 | 6.5 | A 78.0 |
| | | Average | 124.39 | 99.49 | 18.45 | 6.4 | A 76.3 |
| F 63A | | 100 | 116.86 | 93.87 | 18.58 | 7.4 | A 75.0 |
| F 97A | | 100 | 118.77 | 94.25 | 18.58 | 7.7 | A 76.0 |
| F 52A | | 100 | 114.97 | 95.40 | 18.58 | 7.9 | A 76.0 |
| | | Average | 116.87 | 94.51 | 18.58 | 7.7 | A 75.7 |
| F 124A | | 1000 | 101.15 | 78.54 | 18.97 | 11.5 | A 70.0 |
| F 53A | | 1000 | 101.53 | 81.23 | 18.77 | 11.1 | A 70.0 |
| F 76A | | 1000 | 97.70 | 80.46 | 18.77 | 11.8 | A 68.0 |
| | | Average | 100.12 | 80.08 | 18.84 | 11.5 | A 69.3 |

TABLE 21. NOTCHED TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| F 61B | Room | -- | 189.65 | |
| F 87B | | -- | 190.80 | |
| F 24B | | -- | 190.42 | |
| | | Average | 190.29 | 1.029 |
| F 43B | 600 | 0.5 | 174.33 | |
| F 114B | | 0.5 | 175.48 | |
| F 84B | | 0.5 | 173.18 | |
| | | Average | 174.33 | 1.019 |
| G 88N | | 10 | 172.03 | |
| F 111B | | 10 | 169.35 | |
| F 13B | | 10 | 170.11 | |
| | | Average | 170.50 | 1.013 |
| F 54B | | 100 | 172.03 | |
| F 53B | | 100 | 171.65 | |
| F 125B | | 100 | 172.60 | |
| | | Average | 172.09 | 1.022 |
| F 134B | | 1000 | 173.56 | |
| F 63B | | 1000 | 173.18 | |
| F 23B | | 1000 | 173.95 | |
| | | Average | 173.56 | 1.023 |

TABLE 21. NOTCHED TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| F 113B | 900 | 0.5 | 167.05 | |
| F 75B | | 0.5 | 166.28 | |
| F 42B | | 0.5 | 167.82 | |
| | | Average | 167.05 | 1.015 |
| F 121B | | 10 | 163.98 | |
| F 76B | | 10 | 160.92 | |
| F 85B | | 10 | 159.39 | |
| | | Average | 161.43 | 1.027 |
| F 94B | | 100 | 162.45 | |
| F 16B | | 100 | 164.37 | |
| F 126B | | 100 | 163.98 | |
| | | Average | 163.60 | 1.012 |
| F 71B | | 1000 | 166.67 | |
| F 12B | | 1000 | 167.43 | |
| F 55B | | 1000 | 166.67 | |
| | | Average | 166.92 | 1.017 |
| F 62B | 1200 | 0.5 | 163.22 | |
| F 45B | | 0.5 | 164.75 | |
| F 113B | | 0.5 | 162.45 | |
| | | Average | 163.47 | 1.017 |
| F 16B | | 10 | 158.24 | |
| F 125B | | 10 | 159.00 | |
| F 93B | | 10 | 157.09 | |
| | | Average | 158.11 | 1.015 |
| F 41B | | 100 | 162.45 | |
| F 102B | | 100 | 162.45 | |
| F 86B | | 100 | 165.13 | |
| | | Average | 163.34 | 1.012 |
| F 72B | | 1000 | 162.83 | |
| F 30B | | 1000 | 163.60 | |
| F 124B | | 1000 | 163.98 | |
| | | Average | 163.47 | 1.010 |

TABLE 21. NOTCHED TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| F 123B | 1400 | 0.5 | 159.77 | |
| F 44B | | 0.5 | 161.30 | |
| F 92B | | 0.5 | 160.92 | |
| | | Average | 160.66 | 1.106 |
| F 52B | | 10 | 157.47 | |
| F 22B | | 10 | 156.32 | |
| F 115B | | 10 | 156.32 | |
| | | Average | 156.70 | 1.095 |
| F 104B | | 100 | 157.85 | |
| F 36B | | 100 | 155.56 | |
| F 112B | | 100 | 154.79 | |
| | | Average | 156.07 | 1.101 |
| F 56B | | 1000 | 131.03 | |
| F 101B | | 1000 | 132.18 | |
| F 18B | | 1000 | 131.80 | |
| | | Average | 131.67 | 1.002 |
| F 32B | 1500 | 0.5 | 136.02 | |
| F 66B | | 0.5 | 131.42 | |
| F 122B | | 0.5 | 134.10 | |
| | | Average | 133.85 | 1.046 |
| F 81B | | 10 | 132.18 | |
| F 116B | | 10 | 131.80 | |
| F 35B | | 10 | 130.27 | |
| | | Average | 131.42 | 1.057 |
| F 15B | | 100 | 126.82 | |
| F 64B | | 100 | 124.52 | |
| F 105B | | 100 | 125.67 | |
| | | Average | 125.67 | 1.075 |
| F 95B | | 1000 | 104.98 | |
| F 14B | | 1000 | 104.98 | |
| F 51B | | 1000 | 104.60 | |
| | | Average | 104.85 | 1.047 |

TABLE 22. RUPTURE STRENGTHS OF RENÉ 41 BASED ON BOTH ORIGINAL AND FINAL AREAS

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| F 92A | Room | -- | 182.18 | 192.44 |
| F 22A | | -- | 183.59 | 214.12 |
| F 37A | | -- | 180.08 | 195.84 |
| | | Average | 181.95 | 200.80 |
| F 41A | 600 | 0.5 | 163.60 | 191.31 |
| F 103A | | 0.5 | 164.75 | 207.23 |
| F 73A | | 0.5 | 169.73 | 196.37 |
| | | Average | 166.02 | 198.30 |
| F 28A | | 10 | 162.84 | ------* |
| F 116A | | 10 | 160.92 | 187.33 |
| F 25A | | 10 | 168.58 | 198.83 |
| | | Average | 164.11 | 193.08 |
| F 62A | | 100 | 166.67 | 191.63 |
| F 77A | | 100 | 160.15 | 184.96 |
| F 96A | | 100 | 164.75 | 189.01 |
| | | Average | 163.85 | 188.53 |
| F 26A | | 1000 | 168.58 | ------* |
| F 68A | | 1000 | 169.23 | 206.57 |
| F 104A | | 1000 | 168.20 | 208.85 |
| | | Average | 168.67 | 207.71 |

* Invalid test

TABLE 22. RUPTURE STRENGTHS OF RENÉ 41 BASED ON BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| F 108A | 900 | 0.5 | 162.45 | 192.03 |
| F 13A | | 0.5 | 153.26 | 190.29 |
| F 55A | | 0.5 | 160.54 | 189.34 |
| | | Average | 158.73 | 190.55 |
| F 115A | | 10 | 150.19 | 181.73 |
| F 23A | | 10 | 159.00 | 187.36 |
| F 44A | | 10 | 155.94 | 183.91 |
| | | Average | 155.04 | 184.33 |
| F 58A | | 100 | 160.15 | 188.88 |
| F 128A | | 100 | 153.26 | 169.06 |
| F 32A | | 100 | 159.00 | 185.52 |
| | | Average | 157.47 | 181.15 |
| F 105A | | 1000 | 159.00 | 194.47 |
| F 61A | | 1000 | 157.39 | 179.20 |
| F 12A | | 1000 | 158.62 | 184.82 |
| | | Average | 158.33 | 186.16 |
| F 15A | 1200 | 0.5 | 153.26 | 171.16 |
| F 42A | | 0.5 | 155.17 | 173.97 |
| F 106A | | 0.5 | 155.17 | 173.82 |
| | | Average | 154.53 | 172.98 |
| F 47A | | 10 | 153.26 | 168.07 |
| F 118A | | 10 | 149.43 | 162.16 |
| F 11A | | 10 | 153.26 | 173.31 |
| | | Average | 151.98 | 167.84 |
| F 48A | | 100 | 160.92 | 173.55 |
| F 24A | | 100 | 160.92 | 179.72 |
| F 85A | | 100 | 154.02 | 174.18 |
| | | Average | 158.62 | 175.81 |
| F 27A | | 1000 | 160.15 | 173.80 |
| F 78A | | 1000 | 160.92 | 175.73 |
| F 107A | | 1000 | 157.85 | 171.67 |
| | | Average | 159.64 | 173.73 |

TABLE 22. RUPTURE STRENGTHS OF RENÉ 41 BASED ON BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| F 74A | 1400 | 0.5 | 141.76 | 153.21 |
| F 66A | | 0.5 | 140.61 | 151.03 |
| F 121A | | 0.5 | 139.85 | 148.80 |
| | | **Average** | 140.74 | 151.01 |
| F 54A | | 10 | 137.93 | 152.74 |
| F 102A | | 10 | 140.23 | 150.93 |
| F 75A | | 10 | 140.23 | 149.51 |
| | | **Average** | 139.46 | 151.06 |
| F 56A | | 100 | 134.10 | 143.15 |
| F 123A | | 100 | 132.95 | 145.74 |
| F 81A | | 100 | 136.40 | 148.89 |
| | | **Average** | 134.48 | 145.92 |
| F 94A | | 1000 | 123.75 | 134.30 |
| F 126A | | 1000 | 126.82 | 139.25 |
| F 51A | | 1000 | 126.44 | 136.93 |
| | | **Average** | 125.67 | 136.82 |
| F 57A | 1500 | 0.5 | 124.90 | 145.15 |
| F 31A | | 0.5 | 119.92 | 141.76 |
| F 112A | | 0.5 | 122.99 | 143.82 |
| | | **Average** | 122.60 | 143.57 |
| F 45A | | 10 | 113.41 | 131.91 |
| F 21A | | 10 | 114.18 | 132.39 |
| F 33A | | 10 | 114.56 | 135.42 |
| | | **Average** | 114.05 | 133.24 |
| F 63A | | 100 | 108.43 | 126.00 |
| F 97A | | 100 | 105.75 | 123.60 |
| F 52A | | 100 | 104.98 | 124.09 |
| | | **Average** | 106.38 | 124.56 |
| F 124A | | 1000 | [illegible].57 | 104.87 |
| F 53A | | 1000 | 91.95 | 106.15 |
| F 76A | | 1000 | 86.59 | 99.96 |
| | | **Average** | 90.03 | 103.66 |

TABLE 23. COMPRESSIVE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi $\times 10^{-6}$) |
|---|---|---|---|---|
| F 834E | Room | -- | 146.35 | 31.81 |
| F 23E | | -- | 148.50 | 31.38 |
| F 102E | | -- | 146.36 | 31.69 |
| | | Average | 147.07 | 31.63 |
| F 156E | 600 | 0.5 | 146.05 | 29.84 |
| F 91E | | 0.5 | 139.32 | 29.08 |
| F 85E | | 0.5 | 141.76 | 28.79 |
| | | Average | 142.38 | 29.24 |
| F 96E | | 10 | 143.60 | 29.08 |
| F 115E | | 10 | 140.84 | 28.79 |
| F 656E | | 10 | 139.92 | 28.48 |
| | | Average | 141.46 | 28.79 |
| F 83E | | 100 | 145.14 | 29.54 |
| F 103E | | 100 | 141.76 | 29.73 |
| F 46E | | 100 | 139.32 | 28.48 |
| | | Average | 142.07 | 29.25 |
| F 31E | | 1000 | 143.60 | 30.16 |
| F 101E | | 1000 | 139.32 | 29.08 |
| F 1012E | | 1000 | 143.29 | 29.54 |
| | | Average | 142.07 | 29.59 |

TABLE 23. COMPRESSIVE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi $\times 10^{-6}$) |
|---|---|---|---|---|
| F 82E | 900 | 0.5 | 138.04 | 27.45 |
| F 95E | | 0.5 | 137.41 | 28.55 |
| F 74E | | 0.5 | 138.67 | 27.45 |
| | | Average | 138.04 | 27.82 |
| F 1112E | | 10 | 133.65 | 28.24 |
| F 75E | | 10 | 143.37 | 28.55 |
| F 134E | | 10 | 141.18 | 26.67 |
| | | Average | 139.40 | 27.82 |
| F 111E | | 100 | 141.18 | 27.92 |
| F 84E | | 100 | 139.92 | 28.24 |
| F 25E | | 100 | 139.61 | 27.45 |
| | | Average | 140.24 | 27.87 |
| F 104E | | 1000 | 137.79 | 27.25 |
| F 53E | | 1000 | 143.29 | 28.02 |
| F 1256E | | 1000 | 143.91 | 27.09 |
| | | Average | 141.66 | 27.45 |
| F 22E | 1200 | 0.5 | 133.80 | 26.03 |
| F 56E | | 0.5 | 133.33 | 27.09 |
| F 312E | | 0.5 | 139.01 | 27.71 |
| | | Average | 135.38 | 26.95 |
| F 114E | | 10 | 146.05 | 27.45 |
| F 456E | | 10 | 140.24 | 27.56 |
| F 52E | | 10 | 151.25 | 26.94 |
| | | Average | 145.85 | 27.36 |
| F 61E | | 100 | 145.44 | 27.56 |
| F 113E | | 100 | 146.97 | 26.79 |
| F [illegible]4E | | 100 | 143.91 | 27.40 |
| | | Average | 145.44 | 27.25 |
| F 35E | | 1000 | 142.07 | 26.79 |
| F 76E | | 1000 | 143.91 | 26.03 |
| F 434E | | 1000 | 144.21 | 26.79 |
| | | Average | 143.40 | 26.54 |

TABLE 23. COMPRESSIVE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi $\times 10^{-6}$) |
|---|---|---|---|---|
| F 412E | 1400 | 0.5 | 122.66 | 19.90 |
| F 11E | | 0.5 | 131.66 | 23.73 |
| F 65E | | 0.5 | 129.52 | 24.34 |
| | | Average | 127.95 | 24.04 |
| F 334E | | 10 | 136.87 | 23.42 |
| F 36E | | 10 | 131.66 | 25.41 |
| F 81E | | 10 | 140.84 | 23.73 |
| | | Average | 136.46 | 24.19 |
| F 63E | | 100 | 135.94 | 24.50 |
| F 956E | | 100 | 135.64 | 25.26 |
| F 112E | | 100 | 147.27 | 23.73 |
| | | Average | 139.62 | 24.50 |
| F 1134E | | 1000 | 115.12 | 21.43 |
| F 66E | | 1000 | 113.90 | 22.96 |
| F 534E | | 1000 | 113.29 | 22.96 |
| | | Average | 114.10 | 22.45 |
| F 42E | 1500 | 0.5 | 114.51 | 19.51 |
| F 556E | | 0.5 | 115.58 | 19.90 |
| F 71E | | 0.5 | 114.81 | 20.05 |
| | | Average | 114.97 | 19.82 |
| F 93E | | 10 | 106.55 | 18.75 |
| F 33E | | 10 | 108.39 | 19.13 |
| F 856E | | 10 | 107.16 | 18.98 |
| | | Average | 107.37 | 18.95 |
| F 44E | | 100 | 99.51 | 16.53 |
| F 92E | | 100 | 100.28 | 16.53 |
| F 1056E | | 100 | 98.74 | 16.84 |
| | | Average | 99.51 | 16.63 |
| F 812E | | 1000 | 91.55 | 15.00 |
| F 62E | | 1000 | 92.62 | 15.00 |
| F 126E | | 1000 | 91.86 | 14.92 |
| | | Average | 92.01 | 14.97 |

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| F 66C | Room | -- | 296.88 | 240.63 |
| F 121C | | -- | 300.78 | 233.59 |
| F 24C | | -- | 295.31 | 234.38 |
| | | Average | 297.66 | 236.20 |
| F 45C | 600 | 0.5 | 279.30 | 221.88 |
| F 74C | | 0.5 | 279.69 | 222.66 |
| F 92C | | 0.5 | 280.47 | 223.44 |
| | | Average | 279.82 | 222.66 |
| F 101C | | 10 | 277.73 | 221.09 |
| F 124C | | 10 | 278.91 | 221.88 |
| F 83C | | 10 | 278.13 | 221.09 |
| | | Average | 278.26 | 221.35 |
| F 13C | | 100 | 278.13 | 219.53 |
| F 34C | | 100 | 279.69 | 220.31 |
| F 52C | | 100 | 276.95 | 220.70 |
| | | Average | 278.26 | 220.18 |
| F 106C | | 1000 | 278.91 | 221.88 |
| F 63C | | 1000 | 279.69 | 223.44 |
| F 32C | | 1000 | 278.13 | 219.53 |
| | | Average | 278.91 | 221.62 |

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| F 113C | 900 | 0.5 | 274.22 | 216.41 |
| F 51C | | 0.5 | 282.03 | 221.09 |
| F 12C | | 0.5 | 268.75 | 217.97 |
| | | **Average** | 275.00 | 218.49 |
| F 102C | | 10 | 271.88 | 214.06 |
| F 21C | | 10 | 275.00 | 217.97 |
| F 55C | | 10 | 266.41 | 210.94 |
| | | **Average** | 271.10 | 214.32 |
| F 112C | | 100 | 271.09 | 214.06 |
| F 76C | | 100 | 266.41 | 215.63 |
| F 33C | | 100 | 275.78 | 214.84 |
| | | **Average** | 271.09 | 214.84 |
| F 61C | | 1000 | 273.44 | 217.19 |
| F 84C | | 1000 | 266.41 | 212.50 |
| F 115C | | 1000 | 279.69 | 214.84 |
| | | **Average** | 273.18 | 214.84 |
| F 14C | 1200 | 0.5 | 261.72 | 203.91 |
| F 93C | | 0.5 | 257.03 | 205.47 |
| F 56C | | 0.5 | 265.63 | 203.13 |
| | | **Average** | 261.46 | 204.17 |
| F 54C | | 10 | 260.16 | 202.34 |
| F 11C | | 10 | 257.03 | 201.56 |
| F 35C | | 10 | 263.67 | 203.13 |
| | | **Average** | 260.28 | 202.34 |
| F 64C | | 100 | 257.81 | 203.13 |
| F 23C | | 100 | 254.69 | 203.91 |
| F 105C | | 100 | 260.16 | 202.73 |
| | | **Average** | 257.55 | 203.26 |
| F 25C | | 1000 | 259.38 | 202.34 |
| F 125C | | 1000 | 258.59 | 201.56 |
| F 71C | | 1000 | 259.38 | 202.73 |
| | | **Average** | 259.12 | 202.21 |

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| F 82C | 1400 | 0.5 | 230.47 | 188.28 |
| F 126C | | 0.5 | 226.56 | 176.56 |
| F 41C | | 0.5 | 232.81 | 189.84 |
| | | Average | 229.95 | 184.89 |
| F 35C | | 10 | 228.13 | 170.31 |
| F 72C | | 10 | 225.00 | 171.88 |
| F 116C | | 10 | 232.03 | 169.53 |
| | | Average | 228.38 | 170.57 |
| F 81C | | 100 | 221.88 | 167.97 |
| F 43C | | 100 | 225.00 | 166.41 |
| F 16C | | 100 | 218.36 | 169.14 |
| | | Average | 221.75 | 168.51 |
| F 85C | | 1000 | 216.41 | 161.72 |
| F 123C | | 1000 | 210.94 | 162.50 |
| F 42C | | 1000 | 221.09 | 162.89 |
| | | Average | 216.15 | 162.37 |
| F 86C | 1500 | 0.5 | 194.92 | 166.80 |
| F 31C | | 0.5 | 196.09 | 169.53 |
| F 114C | | 0.5 | 193.75 | 167.18 |
| | | Average | 194.92 | 167.84 |
| F 103C | | 10 | 182.03 | 150.78 |
| F 65C | | 10 | 179.69 | 153.13 |
| F 22C | | 10 | 180.08 | 150.78 |
| | | Average | 180.60 | 151.56 |
| F 111C | | 100 | 174.22 | 145.31 |
| F 53C | | 100 | 171.48 | 138.28 |
| F 26C | | 100 | 177.34 | 143.75 |
| | | Average | 174.35 | 142.45 |
| F 94C | | 1000 | 163.28 | 128.13 |
| F 73C | | 1000 | 159.38 | 125.39 |
| F 62C | | 1000 | 162.89 | 128.13 |
| | | Average | 161.85 | 127.22 |

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| F 65D | Room | -- | 367.19 | 288.28 |
| F 82D | | -- | 370.31 | 289.84 |
| F 105D | | -- | 371.78 | 292.97 |
| | | Average | 369.76 | 290.36 |
| F 115D | 600 | 0.5 | 345.31 | 272.65 |
| F 123D | | 0.5 | 344.53 | 271.87 |
| F 81D | | 0.5 | 346.09 | 273.04 |
| | | Average | 345.31 | 272.52 |
| F 24D | | 10 | 343.36 | 270.31 |
| F 126D | | 10 | 342.96 | 270.31 |
| F 101D | | 10 | 342.96 | 269.53 |
| | | Average | 343.09 | 270.05 |
| F 22D | | 100 | 342.57 | 271.87 |
| F 66D | | 100 | 342.18 | 271.09 |
| F 71D | | 100 | 341.79 | 272.65 |
| | | Average | 342.18 | 271.87 |
| F 107D | | 1000 | 343.36 | 271.09 |
| F 26D | | 1000 | 343.75 | 270.31 |
| F 62D | | 1000 | 346.09 | 272.65 |
| | | Average | 344.40 | 271.35 |

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| F 94D | 900 | 0.5 | 338.28 | 264.84 |
| F 56D | | 0.5 | 342.18 | 267.96 |
| F 13D | | 0.5 | 335.93 | 264.45 |
| | | Average | 338.80 | 265.75 |
| F 36D | | 10 | 332.81 | 261.71 |
| F 84D | | 10 | 335.15 | 264.84 |
| F 124D | | 10 | 330.46 | 258.59 |
| | | Average | 332.81 | 261.71 |
| F 114D | | 100 | 335.15 | 263.28 |
| F 11D | | 100 | 334.37 | 265.62 |
| F 72D | | 100 | 336.71 | 258.20 |
| | | Average | 335.41 | 262.37 |
| F 104D | | 1000 | 336.71 | 264.06 |
| F 45D | | 1000 | 336.32 | 263.28 |
| F 83D | | 1000 | 337.50 | 262.50 |
| | | Average | 336.84 | 263.28 |
| F 96D | 1200 | 0.5 | 320.31 | 250.00 |
| F 51D | | 0.5 | 322.65 | 253.90 |
| F 15D | | 0.5 | 323.43 | 250.78 |
| | | Average | 322.13 | 251.56 |
| F 91D | | 10 | 318.75 | 249.21 |
| F 54D | | 10 | 314.84 | 247.65 |
| F 16D | | 10 | 312.50 | 246.87 |
| | | Average | 315.36 | 247.91 |
| F 74D | | 100 | 320.31 | 248.82 |
| F 25D | | 100 | 317.18 | 248.43 |
| F 116D | | 100 | 315.62 | 247.65 |
| | | Average | 317.70 | 248.30 |
| F 113D | | 1000 | 315.62 | 248.43 |
| F 23D | | 1000 | 317.57 | 246.09 |
| F 63D | | 1000 | 319.53 | 253.90 |
| | | Average | 317.57 | 249.47 |

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| F 32D | 1400 | 0.5 | 264.84 | 220.31 |
| F 76D | | 0.5 | 266.40 | 219.53 |
| F 125D | | 0.5 | 264.06 | 222.65 |
| | | Average | 265.10 | 220.83 |
| F 75D | | 10 | 263.28 | 217.18 |
| F 33D | | 10 | 260.93 | 215.62 |
| F 122D | | 10 | 265.62 | 218.75 |
| | | Average | 263.28 | 217.18 |
| F 12D | | 100 | 257.81 | 214.06 |
| F 55D | | 100 | 260.93 | 215.62 |
| F 106D | | 100 | 256.25 | 212.50 |
| | | Average | 258.33 | 214.06 |
| F 42D | | 1000 | 250.00 | 206.25 |
| F 171D | | 1000 | 250.78 | 203.12 |
| F 66D | | 1000 | 254.68 | 210.15 |
| | | Average | 251.82 | 206.51 |
| F 31D | 1500 | 0.5 | 229.68 | 185.15 |
| F 112D | | 0.5 | 226.56 | 185.93 |
| F 73D | | 0.5 | 231.25 | 183.59 |
| | | Average | 229.16 | 184.89 |
| F 35D | | 10 | 225.78 | 182.81 |
| F 121D | | 10 | 223.43 | 179.68 |
| F 85D | | 10 | 227.34 | 184.37 |
| | | Average | 225.52 | 182.29 |
| F 103D | | 100 | 217.18 | 171.87 |
| F 61D | | 100 | 214.84 | 175.00 |
| F 44D | | 100 | 212.50 | 176.56 |
| | | Average | 214.84 | 174.48 |
| F 43D | | 1000 | 189.84 | 166.40 |
| F 102D | | 1000 | 187.50 | 164.50 |
| F 86D | | 1000 | 195.31 | 168.75 |
| | | Average | 190.88 | 166.55 |

TABLE 25. SHEAR PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| F 6F | Room | -- | 113.69 |
| F 5F | | -- | 118.97 |
| F 4F | | -- | 112.88 |
| | | Average | 115.18 |
| F 9F | 600 | 0.5 | 108.13 |
| F 46F | | 0.5 | 110.16 |
| F 61F | | 0.5 | 109.15 |
| | | Average | 109.15 |
| F 34F | | 10 | 109.50 |
| F 45F | | 10 | 108.94 |
| F 67F | | 10 | 109.35 |
| | | Average | 109.22 |
| F 63F | | 100 | 108.94 |
| F 43F | | 100 | 113.41 |
| F 59F | | 100 | 111.18 |
| | | Average | 111.18 |
| F 1F | | 1000 | 111.38 |
| F 2F | | 1000 | 111.13 |
| F 3F | | 1000 | 111.53 |
| | | Average | 111.38 |

TABLE 25. SHEAR PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (° F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| F 14F | 900 | 0.5 | 107.72 |
| F 13F | | 0.5 | 107.30 |
| F 15F | | 0.5 | 107.52 |
| | | Average | 107.51 |
| F 19F | | 10 | 106.10 |
| F 21F | | 10 | 107.72 |
| F 20F | | 10 | 107.32 |
| | | Average | 107.05 |
| F 34F | | 100 | 110.98 |
| F 36F | | 100 | 111.18 |
| F 35F | | 100 | 110.98 |
| | | Average | 111.05 |
| F 33F | | 1000 | 108.54 |
| F 32F | | 1000 | 110.37 |
| F 31F | | 1000 | 109.15 |
| | | Average | 109.35 |
| F 73F | 1200 | 0.5 | 101.63 |
| F 72F | | 0.5 | 103.45 |
| F 71F | | 0.5 | 102.64 |
| | | Average | 102.54 |
| F 29F | | 10 | 106.10 |
| F 28F | | 10 | 107.32 |
| F 30F | | 10 | 106.71 |
| | | Average | 106.71 |
| F 9F | | 100 | 110.16 |
| F 7F | | 100 | 111.79 |
| F 8F | | 100 | 110.98 |
| | | Average | 110.98 |
| F 11F | | 1000 | 108.04 |
| F 10F | | 1000 | 110.16 |
| F 12F | | 1000 | 108.94 |
| | | Average | 109.10 |

TABLE 25. SHEAR PROPERTIES OF RENE 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| F 23F | 1400 | 0.5 | 97.15 |
| F 24F | | 0.5 | 98.37 |
| F 22F | | 0.5 | 97.97 |
| | | Average | 97.76 |
| F 49F | | 10 | 102.44 |
| F 50F | | 10 | 91.46 |
| F 51F | | 10 | 96.95 |
| | | Average | 96.95 |
| F 48F | | 100 | 93.90 |
| F 47F | | 100 | 94.72 |
| F 46F | | 100 | 95.12 |
| | | Average | 94.58 |
| F 37F | | 1000 | 88.21 |
| F 39F | | 1000 | 89.84 |
| F 38F | | 1000 | 89.02 |
| | | Average | 89.03 |
| F 44F | 1500 | 0.5 | 78.05 |
| F 43F | | 0.5 | 80.49 |
| F 45F | | 0.5 | 79.27 |
| | | Average | 79.27 |
| F 41F | | 10 | 74.39 |
| F 40F | | 10 | 74.80 |
| F 42F | | 10 | 74.59 |
| | | Average | 74.60 |
| F 17F | | 100 | 71.95 |
| F 16F | | 100 | 71.34 |
| F 18F | | 100 | 72.76 |
| | | Average | 72.03 |
| F 25F | | 1000 | 64.63 |
| F 26F | | 1000 | 64.23 |
| F 27F | | 1000 | 64.23 |
| | | Average | 64.36 |

TABLE 26. TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi × $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| G 73A | Room | -- | 119.76 | 59.43 | 29.21 | 49.4 | B 92.5 |
| G 34A(T)* | | -- | 120.00 | 60.00 | 28.01 | 49.0 | B 93.0 |
| G 51A | | -- | 111.54 | 57.31 | 30.19 | 49.5 | B 92.5 |
| | | Average | 117.10 | 58.91 | 29.14 | 49.3 | B 92.7 |
| G 22A | 1400 | 0.5 | 60.15 | 31.42 | 20.01 | 41.9 | A 46.0 |
| G 62A | | 0.5 | 59.39 | 32.38 | 22.41 | 41.6 | A 46.0 |
| G 106A | | 0.5 | 59.77 | 32.38 | 21.55 | 41.6 | A 45.0 |
| | | Average | 59.77 | 31.90 | 21.32 | 41.7 | A 45.7 |
| G 42A | | 10 | 55.56 | 34.10 | 21.55 | 46.0 | A 45.0 |
| G 104A | | 10 | 55.56 | 33.33 | 21.07 | 47.0 | A 45.0 |
| G 17A | | 10 | 55.94 | 33.33 | 20.69 | 46.5 | A 46.0 |
| | | Average | 55.68 | 33.58 | 21.10 | 46.5 | A 45.3 |
| G 56A | | 100 | 52.49 | 38.31 | 19.73 | 45.0 | A 50.0 |
| G 93A | | 100 | 50.19 | 37.93 | 20.31 | 45.6 | A 51.0 |
| G 14A | | 100 | 52.80 | 37.50 | 20.29 | 44.3 | A 51.0 |
| | | Average | 51.82 | 37.91 | 20.11 | 44.96 | A 50.7 |
| G 92A | | 1000 | 54.89 | 32.57 | 20.11 | 43.5 | A 55.0 |
| G 65A | | 1000 | 52.49 | 31.42 | 19.73 | 43.9 | A 55.0 |
| G 24A | | 1000 | 54.02 | 31.03 | 20.11 | 43.2 | A 53.0 |
| | | Average | 53.80 | 31.67 | 19.98 | 43.5 | A 54.3 |

*Tuckerman Optical Strain Gage

TABLE 26. TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| G 71A | 1600 | 0.5 | 36.78 | 27.97 | 17.82 | 47.1 | |
| G 107A | | 0.5 | 35.65 | 27.59 | 18.39 | 47.5 | |
| G 96A | | 0.5 | 35.25 | 24.52 | 17.24 | 47.8 | |
| | | Average | 35.89 | 26.69 | 17.81 | 47.4 | |
| G 23A | | 10 | 33.33 | 23.75 | 17.62 | 45.0 | |
| G 105A | | 10 | 33.91 | 25.86 | 19.16 | 47.0 | |
| G 46A | | 10 | 34.48 | 27.97 | 18.20 | 48.0 | |
| | | Average | 33.90 | 25.86 | 18.32 | 46.6 | |
| G 35A | | 100 | 32.18 | 22.22 | 19.16 | 49.3 | |
| G 22A | | 100 | 35.25 | 26.82 | 17.24 | 49.0 | |
| G 96A | | 100 | 34.10 | 24.33 | 18.20 | 49.6 | |
| | | Average | 33.84 | 24.45 | 18.20 | 49.3 | |
| G 57A | | 1000 | 33.72 | 24.52 | 17.62 | 47.5 | |
| G 72A | | 1000 | 34.48 | 25.52 | 16.86 | 46.0 | |
| G 13A | | 1000 | 34.10 | 24.90 | 19.25 | 47.5 | |
| | | Average | 34.10 | 24.98 | 17.91 | 47.0 | |

TABLE 26. TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| G 101A | 1800 | 0.5 | 16.09 | 12.26 | 13.41 | 46.3 | |
| G 74A | | 0.5 | 13.79 | 11.49 | 15.33 | 45.0 | |
| G 43A | | 0.5 | 15.13 | 11.30 | 14.37 | 46.1 | |
| | | Average | 14.94 | 11.88 | 14.37 | 45.8 | |
| G 54A | | 10 | 15.71 | 12.26 | 13.41 | 45.0 | |
| G 36A | | 10 | 15.13 | 10.73 | 14.37 | 45.8 | |
| G 103A | | 10 | 15.52 | 11.30 | 14.37 | 45.8 | |
| | | Average | 15.42 | 11.50 | 14.05 | 45.5 | |
| G 55A | | 100 | 15.33 | 11.49 | 13.89 | 46.8 | |
| G 21A | | 100 | 14.18 | 10.34 | 14.37 | 48.1 | |
| G 82A | | 100 | 14.94 | 10.92 | 13.98 | 47.8 | |
| | | Average | 14.76 | 10.92 | 14.10 | 47.5 | |
| G 87A | | 1000 | 16.86 | 11.49 | 14.37 | 47.1 | |
| G 53A | | 1000 | 14.18 | 10.34 | 13.41 | 44.1 | |
| G 27A | | 1000 | 15.71 | 11.11 | 13.79 | 45.0 | |
| | | Average | 15.52 | 10.92 | 13.86 | 45.4 | |

TABLE 26. TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi × $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| G 61A | 1900 | 0.5 | 11.49 | 9.49 | 11.49 | 37.8 | |
| G 102A | | 0.5 | 12.45 | 9.20 | 9.58 | 38.0 | |
| G 28A | | 0.5 | 12.07 | 9.20 | 11.49 | 38.0 | |
| | | Average | 12.97 | 9.35 | 10.85 | 37.9 | |
| G 77A | | 10 | 12.26 | 9.20 | 13.41 | 37.0 | |
| G 18A | | 10 | 10.73 | 8.81 | 12.45 | 37.5 | |
| G 44A | | 10 | 11.69 | 9.39 | 12.26 | 37.5 | |
| | | Average | 11.50 | 9.01 | 12.70 | 37.3 | |
| G 51A | | 100 | 10.73 | 8.43 | 10.92 | 36.8 | |
| G 37A | | 100 | 12.07 | 7.85 | 10.54 | 38.5 | |
| G 76A | | 100 | 11.49 | 8.43 | 11.11 | 38.1 | |
| | | Average | 11.40 | 8.14 | 10.85 | 37.3 | |
| G 66A | | 1000 | 9.58 | 7.66 | 10.50 | 35.5 | |
| G 47A | | 1000 | 9.58 | 7.66 | 9.95 | 34.0 | |
| G 84A | | 1000 | 9.58 | 8.43 | 10.54 | 34.5 | |
| | | Average | 9.58 | 7.92 | 10.33 | 34.6 | |

TABLE 27. NOTCHED TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| G 96B | Room | -- | 109.23 | |
| G 61B | | -- | 109.40 | |
| G 25B | | -- | 113.67 | |
| | | Average | 110.77 | .946 |
| G 34B | 1400 | 0.5 | 68.05 | |
| G 95B | | 0.5 | 69.36 | |
| G 63B | | 0.5 | 70.57 | |
| | | Average | 69.33 | 1.160 |
| G 41B | | 10 | 72.80 | |
| G 22B | | 10 | 71.76 | |
| G 75B | | 10 | 71.19 | |
| | | Average | 71.92 | 1.294 |
| G 112B | | 100 | 78.46 | |
| G 81B | | 100 | 79.00 | |
| G 26B | | 100 | 75.09 | |
| | | Average | 77.52 | 1.510 |
| G 115B | | 1000 | 66.67 | |
| G 23B | | 1000 | 67.62 | |
| G 62B | | 1000 | 67.05 | |
| | | Average | 67.11 | 1.250 |

TABLE 27. NOTCHED TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| G 53B | 1600 | 0.5 | 50.62 | |
| G 91B | | 0.5 | 52.69 | |
| G 114B | | 0.5 | 51.72 | |
| | | Average | 51.68 | 1.435 |
| G 122B | | 10 | 49.23 | |
| G 54B | | 10 | 48.96 | |
| G 36B | | 10 | 48.96 | |
| | | Average | 49.05 | 1.446 |
| G 83B | | 100 | 51.11 | |
| G 11B | | 100 | 51.37 | |
| G 124B | | 100 | 50.49 | |
| | | Average | 51.02 | 1.513 |
| G 82B | | 1000 | 36.78 | |
| G 35B | | 1000 | 32.95 | |
| G 106B | | 1000 | 34.86 | |
| | | Average | 34.87 | 1.023 |
| G 72B | 1800 | 0.5 | 25.00 | |
| G 94B | | 0.5 | 25.87 | |
| G 33B | | 0.5 | 25.55 | |
| | | Average | 25.47 | 1.705 |
| G 102B | | 10 | 27.12 | |
| G 44B | | 10 | 26.92 | |
| G 13B | | 10 | 27.50 | |
| | | Average | 27.18 | 1.763 |
| G 103B | | 100 | 25.24 | |
| G 14B | | 100 | 26.31 | |
| G 31B | | 100 | 27.59 | |
| | | Average | 26.35 | 1.785 |
| G 46B | | 1000 | 18.39 | |
| G 123B | | 1000 | 17.24 | |
| G 111B | | 1000 | 17.62 | |
| | | Average | 17.75 | 1.144 |

TABLE 27. NOTCHED TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| G 52B | 1900 | 0.5 | 17.69 | |
| G 65B | | 0.5 | 16.89 | |
| G 86B | | 0.5 | 17.24 | |
| | | Average | 17.27 | 1.332 |
| G 43B | | 10 | 16.47 | |
| G 105B | | 10 | 17.70 | |
| G 73B | | 10 | 16.09 | |
| | | Average | 16.75 | 1.457 |
| G 66B | | 100 | 15.71 | |
| G 12B | | 100 | 16.48 | |
| G 113B | | 100 | 15.32 | |
| | | Average | 15.84 | 1.389 |
| G 92B | | 1000 | 14.56 | |
| G 55B | | 1000 | 15.33 | |
| G 121B | | 1000 | 14.56 | |
| | | Average | 14.82 | 1.547 |

TABLE 28. RUPTURE STRENGTHS OF N-155 BASED ON BOTH ORIGINAL AND FINAL AREAS

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| G 73A | Room | -- | 111.50 | 188.10 |
| G 34A | | -- | 111.70 | 190.00 |
| G 51A | | -- | 103.80 | 187.07 |
| | | Average | 109.00 | 188.39 |
| G 25A | 1400 | 0.5 | 49.80 | 83.55 |
| G 62A | | 0.5 | 48.85 | 79.34 |
| G 106A | | 0.5 | 47.51 | 77.50 |
| | | Average | 48.72 | 80.13 |
| G 42A | | 10 | 45.98 | 72.86 |
| G 104A | | 10 | 45.21 | 71.65 |
| G 17A | | 10 | 46.36 | 79.76 |
| | | Average | 45.85 | 74.75 |
| G 56A | | 100 | 37.55 | 75.21 |
| G 93A | | 100 | 44.06 | 90.98 |
| G 14A | | 100 | 45.98 | 82.02 |
| | | Average | 42.53 | 82.73 |
| G 92A | | 1000 | 49.04 | 82.05 |
| G 65A | | 1000 | 45.98 | 92.10 |
| G 24A | | 1000 | 44.44 | 78.11 |
| | | Average | 46.48 | 84.08 |

TABLE 28. RUPTURE STRENGTHS OF N-155 BASED ON BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| G 71A | 1600 | 0.5 | 13.41 | 28.41 |
| G 107A | | 0.5 | 11.49 | 29.04 |
| G 96A | | 0.5 | 16.09 | 37.30 |
| | | Average | 13.66 | 31.58 |
| G 23A | | 10 | 15.33 | 31.75 |
| G 105A | | 10 | 11.49 | 25.47 |
| G 46A | | 10 | 12.26 | 27.23 |
| | | Average | 13.02 | 28.15 |
| G 35A | | 100 | 12.26 | 36.41 |
| G 22A | | 100 | 9.20 | 24.84 |
| G 96A | | 100 | 10.73 | 25.00 |
| | | Average | 10.73 | 28.75 |
| G 13A | | 1000 | 7.66 | 18.92 |
| G 57A | | 1000 | 11.88 | 27.22 |
| G 72A | | 1000 | 8.81 | 17.76 |
| | | Average | 9.45 | 21.30 |
| G 101A | 1800 | 0.5 | 0.38 | 0.84 |
| G 74A | | 0.5 | 0.38 | 0.69 |
| G 43A | | 0.5 | 0.77 | 1.74 |
| | | Average | 0.51 | 1.09 |
| G 54A | | 10 | 0.77 | 1.93 |
| G 36A | | 10 | 0.38 | 1.04 |
| G 103A | | 10 | 0.77 | 1.69 |
| | | Average | 0.64 | 1.55 |
| G 55A | | 100 | 0.77 | 1.88 |
| G 21A | | 100 | 0.38 | 0.88 |
| G 82A | | 100 | 0.38 | 0.98 |
| | | Average | 0.51 | 1.24 |
| G 87A | | 1000 | 0.38 | 0.70 |
| G 53A | | 1000 | 0.77 | 1.43 |
| G 27A | | 1000 | 0.38 | 0.88 |
| | | Average | 0.51 | 0.67 |

TABLE 28. RUPTURE STRENGTHS OF N-155 BASED ON BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| G 61A | 1900 | 0.5 | 0.38 | 0.65 |
| G 102A | | 0.5 | 0.38 | 0.73 |
| G 28A | | 0.5 | 0.38 | 0.67 |
| | | **Average** | 0.38 | 0.68 |
| G 77A | | 10 | 0.38 | 0.67 |
| G 18A | | 10 | 0.38 | 0.69 |
| G 44A | | 10 | 0.38 | 0.69 |
| | | **Average** | 0.38 | 0.68 |
| G 51A | | 100 | 0.38 | 0.56 |
| G 37A | | 100 | 0.38 | 0.65 |
| G 76A | | 100 | 0.38 | 0.71 |
| | | **Average** | 0.38 | 0.64 |
| G 66A | | 1000 | 0.38 | 0.64 |
| G 47A | | 1000 | 0.38 | 0.55 |
| G 84A | | 1000 | 0.38 | 0.65 |
| | | **Average** | 0.38 | 0.61 |

TABLE 29. COMPRESSIVE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi $\times 10^{-6}$) |
|---|---|---|---|---|
| G 86E | Room | -- | 50.56 | 29.44 |
| G 1056E | | -- | 52.80 | 29.60 |
| G 456E | | -- | 53.76 | 30.24 |
| | | Average | 52.37 | 29.76 |
| G 76E | 1400 | 0.5 | 40.00 | 21.60 |
| G 33E | | 0.5 | 39.36 | 21.44 |
| G 91E | | 0.5 | 39.36 | 21.28 |
| | | Average | 39.57 | 21.44 |
| G 14E | | 10 | 39.36 | 21.20 |
| G 31E | | 10 | 39.04 | 21.12 |
| G 92E | | 10 | 39.20 | 20.64 |
| | | Average | 39.20 | 20.99 |
| G 41E | | 100 | 38.72 | 20.96 |
| G 82E | | 100 | 38.40 | 20.80 |
| G 626# | | 100 | 39.36 | 21.20 |
| | | Average | 38.83 | 20.99 |
| G 65E | | 1000 | 38.08 | 20.64 |
| G 32E | | 1000 | 37.76 | 20.32 |
| G 83E | | 1000 | 38.08 | 20.48 |
| | | Average | 37.97 | 20.48 |

TABLE 29. COMPRESSIVE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi $\times 10^{-6}$) |
|---|---|---|---|---|
| G 84E | 1600 | 0.5 | 30.08 | 17.60 |
| G 102E | | 0.5 | 30.40 | 17.76 |
| G 25E | | 0.5 | 30.72 | 18.08 |
| | | Average | 30.40 | 17.81 |
| G 61E | | 10 | 29.60 | 17.28 |
| G 42E | | 10 | 29.44 | 17.28 |
| G 24E | | 10 | 29.76 | 17.44 |
| | | Average | 29.60 | 17.33 |
| G 94E | | 100 | 28.48 | 16.80 |
| G 72E | | 100 | 28.80 | 16.96 |
| G 43E | | 100 | 29.12 | 17.12 |
| | | Average | 28.80 | 16.96 |
| G 96E | | 1000 | 26.40 | 15.84 |
| G 73E | | 1000 | 26.88 | 16.00 |
| G 44E | | 1000 | 27.20 | 16.16 |
| | | Average | 26.83 | 16.00 |
| G 71E | 1800 | 0.5 | 17.28 | 13.60 |
| G 104E | | 0.5 | 18.56 | 14.08 |
| G 36E | | 0.5 | 17.60 | 13.60 |
| | | Average | 17.81 | 13.76 |
| G 65E | | 10 | 16.32 | 13.52 |
| G 16E | | 10 | 16.80 | 13.20 |
| G 112E | | 10 | 16.96 | 13.44 |
| | | Average | 16.69 | 13.39 |
| G 95E | | 100 | 16.32 | 12.96 |
| G 12E | | 100 | 16.32 | 13.12 |
| G 66E | | 100 | 15.68 | 13.60 |
| | | Average | 16.11 | 13.23 |
| G 1034E | | 1000 | 15.68 | 12.48 |
| G 412E | | 1000 | 15.36 | 12.32 |
| G 156E | | 1000 | 14.72 | 13.76 |
| | | Average | 15.25 | 12.85 |

TABLE 29. COMPRESSIVE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi × $10^{-6}$) |
|---|---|---|---|---|
| G 62E | 1900 | 0.5 | 12.48 | 10.56 |
| G 756E | | 0.5 | 12.16 | 10.40 |
| G 234E | | 0.5 | 12.00 | 10.40 |
| | | **Average** | 12.21 | 10.45 |
| G 556E | | 10 | 11.52 | 10.08 |
| G 512E | | 10 | 12.00 | 10.24 |
| G 63E | | 10 | 11.84 | 10.24 |
| | | **Average** | 11.79 | 10.19 |
| G 11E | | 100 | 9.60 | 9.60 |
| G 101E | | 100 | 10.24 | 9.92 |
| G 64E | | 100 | 9.92 | 9.76 |
| | | **Average** | 9.92 | 9.76 |
| G 103E | | 1000 | 7.68 | 8.00 |
| G 46E | | 1000 | 8.64 | 8.32 |
| G 75E | | 1000 | 8.32 | 8.16 |
| | | **Average** | 8.21 | 8.16 |

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| G 35C | Room | -- | 199.20 | 85.60 |
| G 46C | | -- | 199.20 | 92.00 |
| G 1C | | -- | 196.00 | 89.60 |
| | | Average | 198.13 | 89.07 |
| G 76C | 1400 | 0.5 | 111.60 | 65.60 |
| G 54C | | 0.5 | 108.80 | 60.80 |
| G 12C | | 0.5 | 110.40 | 63.20 |
| | | Average | 110.26 | 63.20 |
| G 81C | | 10 | 105.60 | 66.80 |
| G 44C | | 10 | 107.20 | 65.60 |
| G 53C | | 10 | 106.40 | 66.40 |
| | | Average | 106.40 | 66.26 |
| G 83C | | 100 | 107.20 | 74.40 |
| G 66C | | 100 | 112.80 | 78.40 |
| G 42C | | 100 | 110.00 | 76.40 |
| | | Average | 110.00 | 76.40 |
| G 71C | | 1000 | 109.60 | 73.60 |
| G 92C | | 1000 | 110.00 | 73.60 |
| G 15C | | 1000 | 110.00 | 73.60 |
| | | Average | 109.86 | 73.60 |

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| G 13C | 1600 | 0.5 | 61.20 | 48.00 |
| G 86C | | 0.5 | 59.20 | 46.40 |
| G 34C | | 0.5 | 55.20 | 44.00 |
| | | Average | 58.53 | 46.13 |
| G 93C | | 10 | 60.00 | 43.20 |
| G 61C | | 10 | 58.00 | 44.00 |
| G 25C | | 10 | 57.60 | 44.00 |
| | | Average | 58.53 | 43.73 |
| G 104C | | 100 | 59.20 | 44.00 |
| G 11C | | 100 | 57.20 | 41.60 |
| G 33C | | 100 | 51.20 | 41.60 |
| | | Average | 55.86 | 42.40 |
| G 43C | | 1000 | 57.60 | 40.80 |
| G 74C | | 1000 | 56.80 | 43.20 |
| G 96C | | 1000 | 55.20 | 38.40 |
| | | Average | 56.53 | 40.80 |
| G 31C | 1800 | 0.5 | 33.20 | 24.00 |
| G 125C | | 0.5 | 34.80 | 22.00 |
| G 56C | | 0.5 | 34.00 | 23.20 |
| | | Average | 34.00 | 23.00 |
| G 62C | | 10 | 32.00 | 24.00 |
| G 95C | | 10 | 32.00 | 21.60 |
| G 36C | | 10 | 32.80 | 22.80 |
| | | Average | 32.26 | 22.80 |
| G 41C | | 100 | 31.60 | 25.20 |
| G 14C | | 100 | 31.60 | 20.00 |
| G 85C | | 100 | 32.00 | 22.40 |
| | | Average | 31.73 | 22.53 |
| G 106C | | 1000 | 35.20 | 16.00 |
| G 23C | | 1000 | 31.20 | 23.20 |
| G 26C | | 1000 | 34.40 | 19.60 |
| | | Average | 33.60 | 19.60 |

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| G 51C | 1900 | 0.5 | 26.40 | 16.40 |
| G 45C | | 0.5 | 29.60 | 26.40 |
| G 75C | | 0.5 | 28.00 | 21.20 |
| | | Average | 28.00 | 21.33 |
| G 126C | | 10 | 25.20 | 20.00 |
| G 105C | | 10 | 28.80 | 19.20 |
| G 84C | | 10 | 26.80 | 19.60 |
| | | Average | 26.93 | 19.60 |
| G 22C | | 100 | 23.20 | 20.00 |
| G 121C | | 100 | 24.80 | 15.20 |
| G 55C | | 100 | 24.00 | 17.60 |
| | | Average | 24.00 | 17.60 |
| G 82C | | 1000 | 23.20 | 17.60 |
| G 103C | | 1000 | 25.20 | 20.00 |
| G 16C | | 1000 | 24.40 | 18.80 |
| | | Average | 24.26 | 18.80 |

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| G 86D | Room | -- | 262.40 | 132.80 |
| G 11D | | -- | 259.20 | 116.80 |
| G 116D | | -- | 256.00 | 100.80 |
| | | Average | 259.20 | 116.80 |
| G 16D | 1400 | 0.5 | 143.20 | 76.00 |
| G 81D | | 0.5 | 139.20 | 68.00 |
| G 64D | | 0.5 | 141.20 | 72.00 |
| | | Average | 141.20 | 72.00 |
| G 66D | | 10 | 132.00 | 82.00 |
| G 85D | | 10 | 134.40 | 83.20 |
| G 22D | | 10 | 133.20 | 82.40 |
| | | Average | 133.20 | 82.53 |
| G 51D | | 100 | 136.40 | 86.80 |
| G 83D | | 100 | 133.60 | 90.40 |
| G 13D | | 100 | 135.20 | 86.00 |
| | | Average | 135.06 | 87.73 |
| G 98D | | 1000 | 135.60 | 85.20 |
| G 33D | | 1000 | 136.00 | 94.40 |
| G 74D | | 1000 | 136.00 | 90.00 |
| | | Average | 135.86 | 89.86 |

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| G 77D | 1600 | 0.5 | 70.00 | 51.60 |
| G 102D | | 0.5 | 75.60 | 57.20 |
| G 61D | | 0.5 | 72.00 | 32.20 |
| | | **Average** | 72.53 | 48.00 |
| G 63D | | 10 | 73.20 | 55.60 |
| G 21D | | 10 | 83.20 | 54.00 |
| G 94D | | 10 | 71.20 | 39.20 |
| | | **Average** | 75.86 | 49.60 |
| G 84D | | 100 | 72.80 | 46.00 |
| G 11D | | 100 | 71.60 | 49.60 |
| G 35D | | 100 | 71.20 | 47.20 |
| | | **Average** | 71.86 | 47.60 |
| G 72D | | 1000 | 70.40 | 45.20 |
| G 95D | | 1000 | 69.60 | 47.60 |
| G 36D | | 1000 | 64.80 | 46.40 |
| | | **Average** | 68.26 | 46.33 |
| G 75D | 1800 | 0.5 | 44.00 | 20.00 |
| G 46D | | 0.5 | 41.60 | 24.00 |
| G 12D | | 0.5 | 42.80 | 22.00 |
| | | **Average** | 42.80 | 22.00 |
| G 41D | | 10 | 37.60 | 26.40 |
| G 93D | | 10 | 38.00 | 30.00 |
| G 62D | | 10 | 38.00 | 28.00 |
| | | **Average** | 37.86 | 28.13 |
| G 24D | | 100 | 37.60 | 29.60 |
| G 55D | | 100 | 38.40 | 19.20 |
| G 96D | | 100 | 38.00 | 24.40 |
| | | **Average** | 38.00 | 24.40 |
| G 25D | | 1000 | 40.00 | 20.00 |
| G 32D | | 1000 | 40.00 | 20.00 |
| G 82D | | 1000 | 39.20 | 19.60 |
| | | **Average** | 39.73 | 19.86 |

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| G 73D | 1900 | 0.5 | 32.80 | 28.80 |
| G 56D | | 0.5 | 36.80 | 19.20 |
| G 104D | | 0.5 | 36.40 | 23.00 |
| | | **Average** | 35.33 | 23.66 |
| G 91D | | 10 | 30.40 | 22.80 |
| G 65D | | 10 | 34.80 | 16.00 |
| G 42D | | 10 | 32.40 | 19.20 |
| | | **Average** | 32.53 | 19.33 |
| G 103D | | 100 | 32.00 | 20.40 |
| G 14D | | 100 | 31.20 | 22.80 |
| G 52D | | 100 | 31.60 | 21.60 |
| | | **Average** | 31.60 | 21.60 |
| G 34D | | 1000 | 30.80 | 20.80 |
| G 76D | | 1000 | 30.40 | 16.80 |
| G 112D | | 1000 | 30.80 | 18.80 |
| | | **Average** | 30.66 | 18.80 |

TABLE 31. SHEAR PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| G 6F | Room | -- | 83.26 |
| G 43F | | -- | 84.76 |
| G 67F | | -- | 84.02 |
| | | Average | 84.01 |
| G 41F | 1400 | 0.5 | 43.67 |
| G 4F | | 0.5 | 44.31 |
| G 20F | | 0.5 | 44.72 |
| | | Average | 44.23 |
| G 5F | | 10 | 44.31 |
| G 42F | | 10 | 42.28 |
| G 66F | | 10 | 43.50 |
| | | Average | 43.36 |
| G 65F | | 100 | 40.20 |
| G 20F | | 100 | 41.06 |
| G 10F | | 100 | 42.28 |
| | | Average | 41.18 |
| G 14F | | 1000 | 40.65 |
| G 63F | | 1000 | 42.68 |
| G 47F | | 1000 | 41.06 |
| | | Average | 41.46 |

TABLE 31. SHEAR PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| G 22F | 1600 | 0.5 | 28.25 |
| G 27F | | 0.5 | 28.25 |
| G 60F | | 0.5 | 28.05 |
| | | Average | 28.18 |
| G 17F | | 10 | 27.24 |
| G 59F | | 10 | 27.64 |
| G 21F | | 10 | 27.42 |
| | | Average | 27.43 |
| G 40F | | 100 | 26.42 |
| G 30F | | 100 | 26.02 |
| G 26F | | 100 | 26.22 |
| | | Average | 26.22 |
| G 77F | | 1000 | 23.58 |
| G 79F | | 1000 | 23.98 |
| G 78F | | 1000 | 23.17 |
| | | Average | 23.58 |
| G 9F | 1800 | 0.5 | 17.07 |
| G 18F | | 0.5 | 17.07 |
| G 25F | | 0.5 | 16.66 |
| | | Average | 16.93 |
| G 55F | | 10 | 16.87 |
| G 49F | | 10 | 16.66 |
| G 37F | | 10 | 16.66 |
| | | Average | 16.73 |
| G 19F | | 100 | 16.66 |
| G 15F | | 100 | 16.26 |
| G 16F | | 100 | 17.07 |
| | | Average | 16.66 |
| G 80F | | 1000 | 15.04 |
| G 81F | | 1000 | 14.64 |
| G 51F | | 1000 | 15.04 |
| | | Average | 14.91 |

TABLE 31. SHEAR PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| G 57F | 1900 | 0.5 | 14.63 |
| G 62F | | 0.5 | 17.07 |
| G 45F | | 0.5 | 15.85 |
| | | **Average** | 15.85 |
| G 3F | | 10 | 13.82 |
| G 52F | | 10 | 15.85 |
| G 2F | | 10 | 14.84 |
| | | **Average** | 14.84 |
| G 58F | | 100 | 15.04 |
| G 33F | | 100 | 14.63 |
| G 53F | | 100 | 14.23 |
| | | **Average** | 14.63 |
| G 76F | | 1000 | 14.23 |
| G 75F | | 1000 | 14.63 |
| G 74F | | 1000 | 14.43 |
| | | **Average** | 14.43 |

TABLE 32. TENSILE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi X $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| D 17A(T)* | Room | -- | 273.70 | 258.00 | 25.50 | 3.2 | C 52.0 |
| D 312A | | -- | 269.02 | 256.86 | 25.29 | 3.0 | C 52.5 |
| D 48A | | -- | 273.73 | 259.22 | 25.88 | 3.0 | C 52.0 |
| | | Average | 272.15 | 258.03 | 25.56 | 3.1 | C 52.1 |
| D 16A | 400 | 0.5 | 249.41 | 225.88 | 24.31 | 2.9 | C 47.5 |
| D 213A | | 0.5 | 249.02 | 227.45 | 24.31 | 2.8 | C 47.0 |
| D 28A | | 0.5 | 250.98 | 228.24 | 24.51 | 2.8 | C 47.0 |
| | | Average | 249.80 | 227.19 | 24.38 | 2.8 | C 47.1 |
| D 51A | | 10 | 245.88 | 231.37 | 24.51 | 2.9 | C 46.0 |
| D 310A | | 10 | 246.67 | 229.80 | 24.71 | 2.8 | C 46.0 |
| D 410A | | 10 | 248.24 | 230.20 | 24.90 | 2.7 | C 45.0 |
| | | Average | 246.93 | 230.46 | 24.71 | 2.8 | C 45.6 |
| D 114A | | 100 | 248.63 | 236.08 | 24.71 | 2.5 | C 47.0 |
| D 42A | | 100 | 249.02 | 235.29 | 24.90 | 2.8 | C 47.0 |
| D 39A | | 100 | 248.63 | 232.94 | 24.71 | 3.1 | C 47.0 |
| | | Average | 248.76 | 234.77 | 24.77 | 2.8 | C 47.0 |
| D 61A | | 1000 | 248.43 | 226.67 | 24.51 | 2.9 | C 48.0 |
| D 210A | | 1000 | 251.76 | 227.06 | 24.51 | 2.9 | C 48.0 |
| D 23A | | 1000 | 247.84 | 223.53 | 24.31 | 2.5 | C 47.0 |
| | | Average | 249.34 | 225.75 | 24.44 | 2.8 | C 47.6 |

*Tuckerman Optical Strain Gage

TABLE 32. TENSILE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi × $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| D 32A | 600 | 0.5 | 237.25 | 218.82 | 22.57 | 4.0 | C 43.5 |
| D 18A | | 0.5 | 234.51 | 217.71 | 22.54 | 4.1 | C 43.0 |
| D 64A | | 0.5 | 237.65 | 215.80 | 22.94 | 3.8 | C 43.0 |
| | | Average | 236.47 | 217.44 | 22.68 | 4.0 | C 43.1 |
| D 43A | | 10 | 241.18 | 229.41 | 23.52 | 2.5 | C 45.0 |
| D 65A | | 10 | 236.80 | 224.71 | 23.52 | 2.4 | C 46.0 |
| D 47A | | 10 | 244.71 | 223.92 | 23.73 | 2.4 | C 44.0 |
| | | Average | 240.90 | 226.01 | 23.59 | 2.4 | C 45.0 |
| D 41A | | 100 | 239.22 | 223.53 | 23.13 | 2.5 | C 45.0 |
| D 69A | | 100 | 238.43 | 222.35 | 23.13 | 2.6 | C 47.0 |
| D 62A | | 100 | 239.61 | 234.51 | 23.33 | 2.6 | C 47.0 |
| | | Average | 239.09 | 226.80 | 23.20 | 2.6 | C 46.3 |
| D 212A | | 1000 | 250.20 | 234.90 | 23.52 | 2.3 | C 48.0 |
| D 13A | | 1000 | 249.02 | 234.51 | 23.73 | 2.6 | C 47.5 |
| D 21A | | 1000 | 249.02 | 233.73 | 23.52 | 2.4 | C 48.0 |
| | | Average | 249.41 | 234.38 | 23.60 | 2.4 | C 47.8 |

TABLE 32. TENSILE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi $\times 10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| D 15A | 800 | 0.5 | 231.37 | 213.73 | 21.56 | 3.8 | C 44.0 |
| D 22A | | 0.5 | 231.76 | 211.76 | 21.56 | 4.1 | C 43.0 |
| D 211A | | 0.5 | 233.33 | 216.86 | 21.96 | 4.0 | C 43.0 |
| | | Average | 232.15 | 214.12 | 21.69 | 4.0 | C 43.3 |
| D 413A | | 10 | 220.78 | 205.10 | 22.35 | 4.0 | C 40.5 |
| D 313A | | 10 | 223.53 | 200.00 | 22.15 | 4.2 | C 43.0 |
| D 31A | | 10 | 228.63 | 211.76 | 22.15 | 3.9 | C 42.0 |
| | | Average | 224.31 | 205.62 | 22.22 | 4.0 | C 41.8 |
| D 113A | | 100 | 203.92 | 185.10 | 21.96 | 4.4 | C 41.0 |
| D 33A | | 100 | 205.10 | 186.27 | 21.96 | 4.5 | C 41.0 |
| D 24A | | 100 | 208.24 | 182.35 | 21.76 | 4.1 | C 40.5 |
| | | Average | 205.75 | 184.57 | 21.89 | 4.3 | C 40.8 |
| D 45A | | 1000 | 184.31 | 161.96 | 22.15 | 3.8 | C 41.0 |
| D 63A | | 1000 | 183.92 | 161.96 | 21.56 | 3.6 | C 40.0 |
| D 66A | | 1000 | 186.27 | 162.75 | 21.76 | 3.8 | C 38.0 |
| | | Average | 184.83 | 162.22 | 21.82 | 3.7 | C 39.6 |

TABLE 32. TENSILE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Yield Strength (ksi) | E (psi × $10^{-6}$) | Elongation in 2 inches (%) | Hardness (Rockwell) |
|---|---|---|---|---|---|---|---|
| D 52A | 1000 | 0.5 | 99.61 | 70.59 | 17.06 | 17.0 | A 67.0 |
| D 412A | | 0.5 | 98.04 | 73.73 | 17.25 | 16.8 | A 68.0 |
| D 112A | | 0.5 | 98.03 | 70.59 | 17.25 | 16.4 | A 66.5 |
| | | Average | 98.56 | 71.64 | 17.19 | 16.7 | A 67.1 |
| D 19A | | 10 | 109.80 | 83.53 | 18.24 | 22.7 | A 63.0 |
| D 37A | | 10 | 109.41 | 84.71 | 18.43 | 20.8 | A 63.0 |
| D 25A | | 10 | 103.82 | 77.64 | 18.04 | 20.0 | A 62.0 |
| | | Average | 107.68 | 81.96 | 18.24 | 21.2 | A 62.6 |
| D 64A | | 100 | 92.16 | 76.08 | 17.06 | 16.7 | A 53.0 |
| D 27A | | 100 | 90.19 | 76.47 | 17.25 | 17.0 | A 54.0 |
| D 44A | | 100 | 93.33 | 77.25 | 17.25 | 15.0 | A 55.0 |
| | | Average | 91.89 | 76.60 | 17.19 | 16.2 | A 54.0 |
| D 67A | | 1000 | 70.20 | 60.78 | 17.06 | 18.2 | A 52.0 |
| D 11A | | 1000 | 67.84 | 61.18 | 16.86 | 18.1 | A 52.0 |
| D 14A | | 1000 | 72.15 | 62.35 | 16.86 | 18.5 | A 53.0 |
| | | Average | 70.06 | 61.44 | 16.93 | 18.3 | A 52.3 |

TABLE 33. NOTCHED TENSILE PROPERTIES OF 301(60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| D 18B | Room | -- | 282.35 | |
| D 22B | | -- | 284.35 | |
| D 37B | | -- | 283.92 | |
| | | Average | 283.53 | 1.042 |
| D 12B | 400 | 0.5 | 266.27 | |
| D 19B | | 0.5 | 265.88 | |
| D 62B | | 0.5 | 266.27 | |
| | | Average | 266.47 | 1.067 |
| D 410B | | 10 | 260.98 | |
| D 54B | | 10 | 260.78 | |
| D 64B | | 10 | 261.17 | |
| | | Average | 260.98 | 1.057 |
| D 15B | | 100 | 263.53 | |
| D 310B | | 100 | 263.14 | |
| D 43 B | | 100 | 263.73 | |
| | | Average | 263.47 | 1.059 |
| D 13B | | 1000 | 264.71 | |
| D 52B | | 1000 | 264.71 | |
| D 45B | | 1000 | 263.92 | |
| | | Average | 264.31 | 1.060 |

TABLE 33. NOTCHED TENSILE PROPERTIES OF 301(60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| D 33B | 600 | 0.5 | 254.90 | |
| D 49B | | 0.5 | 255.69 | |
| D 34B | | 0.5 | 255.29 | |
| | | Average | 255.30 | 1.080 |
| D 63B | | 10 | 258.82 | |
| D 313B | | 10 | 260.00 | |
| D 311B | | 10 | 260.78 | |
| | | Average | 259.87 | 1.079 |
| D 24B | | 100 | 258.43 | |
| D 31B | | 100 | 257.25 | |
| D 11B | | 100 | 258.04 | |
| | | Average | 257.91 | 1.079 |
| D 210B | | 1000 | 263.53 | |
| D 610B | | 1000 | 262.35 | |
| D 42B | | 1000 | 262.75 | |
| | | Average | 262.88 | 1.054 |
| D 46B | 800 | 0.5 | 243.14 | |
| D 53B | | 0.5 | 247.06 | |
| D 68B | | 0.5 | 240.39 | |
| | | Average | 243.53 | 1.049 |
| D 211B | | 10 | 245.49 | |
| D 38B | | 10 | 245.88 | |
| D 65B | | 10 | 244.71 | |
| | | Average | 245.36 | 1.094 |
| D 64B | | 100 | 217.25 | |
| D 21B | | 100 | 216.86 | |
| D 41B | | 100 | 214.12 | |
| | | Average | 216.08 | 1.050 |
| D 14B | | 1000 | 194.12 | |
| D 48B | | 1000 | 195.69 | |
| D 36B | | 1000 | 192.16 | |
| | | Average | 193.99 | 1.050 |

TABLE 33. NOTCHED TENSILE PROPERTIES OF 301(60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Tensile Strength (ksi) | Notched Strength Ratio |
|---|---|---|---|---|
| D 25B | 1000 | 0.5 | 123.53 | |
| D 112B | | 0.5 | 122.75 | |
| D 21B | | 0.5 | 122.75 | |
| | | Average | 123.01 | 1.248 |
| D 61B | | 10 | 136.86 | |
| D 413B | | 10 | 136.08 | |
| D 26B | | 10 | 130.98 | |
| | | Average | 134.64 | 1.250 |
| D 47B | | 100 | 106.67 | |
| D 314B | | 100 | 107.06 | |
| D 111B | | 100 | 108.24 | |
| | | Average | 107.32 | 1.168 |
| D 67B | | 1000 | 91.37 | |
| D 412B | | 1000 | 97.65 | |
| D 16B | | 1000 | 94.12 | |
| | | Average | 94.38 | 1.347 |

TABLE 34. RUPTURE STRENGTHS OF 301 (60% COLD REDUCED) STAINLESS STEEL BASED ON BOTH ORIGINAL AND FINAL AREAS

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| D 48A | Room | -- | 236.59 | 251.57 |
| D 15A | | -- | 235.29 | 263.16 |
| D 312A | | -- | 239.22 | 283.72 |
| | | Average | 237.03 | 266.15 |
| D 28A | 400 | 0.5 | 236.08 | 264.61 |
| D 16A | | 0.5 | 246.27 | 269.76 |
| D 213A | | 0.5 | 235.29 | 257.73 |
| | | Average | 239.21 | 264.03 |
| D 51A | | 10 | 240.39 | 266.06 |
| D 410A | | 10 | 243.14 | 268.51 |
| D 310A | | 10 | 240.00 | 253.94 |
| | | Average | 241.18 | 262.84 |
| D 114A | | 100 | 247.06 | 270.04 |
| D 42A | | 100 | 242.74 | 268.20 |
| D 39A | | 100 | 243.13 | 250.51 |
| | | Average | 244.31 | 262.92 |
| D 210A | | 1000 | 231.37 | 266.61 |
| D 61A | | 1000 | 239.22 | 273.42 |
| D 23A | | 1000 | 229.41 | 258.73 |
| | | Average | 233.33 | 266.25 |

TABLE 34. RUPTURE STRENGTHS OF 301 (60% COLD REDUCED) STAINLESS STEEL BASED ON BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| D 32A | 600 | 0.5 | 231.36 | 253.98 |
| D 18A | | 0.5 | 234.51 | 265.07 |
| D 64A | | 0.5 | 234.31 | 261.60 |
| | | Average | 233.39 | 260.22 |
| D 43A | | 10 | 237.25 | 251.04 |
| D 47A | | 10 | 238.98 | 260.74 |
| D 65A | | 10 | 234.50 | 255.77 |
| | | Average | 236.91 | 255.85 |
| D 41A | | 100 | 221.56 | 228.28 |
| D 69A | | 100 | 221.17 | 234.90 |
| D 62A | | 100 | 223.53 | 236.51 |
| | | Average | 222.09 | 233.23 |
| D 212A | | 1000 | 246.27 | 262.65 |
| D 13A | | 1000 | 239.21 | 255.66 |
| D 21A | | 1000 | 238.43 | 250.21 |
| | | Average | 241.30 | 256.17 |
| D 15A | 800 | 0.5 | 219.60 | 251.12 |
| D 22A | | 0.5 | 215.68 | 269.21 |
| D 211A | | 0.5 | 218.82 | 247.56 |
| | | Average | 218.03 | 255.96 |
| D 413A | | 10 | 213.72 | 242.10 |
| D 313A | | 10 | 210.58 | 235.11 |
| D 31A | | 10 | 215.29 | 255.71 |
| | | Average | 213.20 | 244.31 |
| D 113A | | 100 | 194.51 | 213.10 |
| D 33A | | 100 | 191.40 | 221.90 |
| D 24A | | 100 | 192.15 | 213.97 |
| | | Average | 192.69 | 216.33 |
| D 45A | | 1000 | 172.94 | 197.49 |
| D 63A | | 1000 | 166.67 | 181.62 |
| D 66A | | 1000 | 170.59 | 185.90 |
| | | Average | 170.07 | 188.34 |

TABLE 34. RUPTURE STRENGTHS OF 301 (60% COLD REDUCED) STAINLESS STEEL BASED ON BOTH ORIGINAL AND FINAL AREAS (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Based on Original Area (ksi) | Based on Final Area (ksi) |
|---|---|---|---|---|
| D 412A | 1000 | 0.5 | 64.70 | 114.98 |
| D 112A | | 0.5 | 61.18 | 122.16 |
| D 52A | | 0.5 | 65.88 | 109.30 |
| | | Average | 63.92 | 115.48 |
| D 25A | | 10 | 64.31 | 101.30 |
| D 37A | | 10 | 62.74 | 101.27 |
| D 19A | | 10 | 58.04 | 97.43 |
| | | Average | 61.70 | 100.00 |
| D 27A | | 100 | 58.04 | 99.80 |
| D 44A | | 100 | 68.63 | 95.47 |
| D 64A | | 100 | 60.78 | 91.99 |
| | | Average | 62.48 | 95.75 |
| D 67A | | 1000 | 49.41 | 77.49 |
| D 11A | | 1000 | 49.02 | 78.62 |
| D 14A | | 1000 | 50.98 | 78.46 |
| | | Average | 49.80 | 78.19 |

TABLE 35. COMPRESSIVE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi $\times 10^{-6}$) |
|---|---|---|---|---|
| D 29E | Room | -- | 207.69 | 26.98 |
| D 210E | | -- | 207.37 | 26.66 |
| D 226E | | -- | 204.24 | 26.98 |
| | | Average | 206.47 | 26.87 |
| D 211E | 400 | 0.5 | 185.10 | 24.00 |
| D 28E | | 0.5 | 194.51 | 24.63 |
| D 14E | | 0.5 | 195.14 | 25.25 |
| | | Average | 191.58 | 24.63 |
| D 115E | | 10 | 207.06 | 25.98 |
| D 218E | | 10 | 213.33 | 25.57 |
| D 212E | | 10 | 202.35 | 25.57 |
| | | Average | 207.58 | 25.71 |
| D 311E | | 100 | 216.78 | 25.73 |
| D 13E | | 100 | 213.33 | 25.25 |
| D 127E | | 100 | 209.88 | 25.73 |
| | | Average | 213.33 | 25.57 |
| D 121E | | 1000 | 218.67 | 25.41 |
| D 25E | | 1000 | 212.08 | 25.10 |
| D 38E | | 1000 | 215.84 | 25.73 |
| | | Average | 215.53 | 25.41 |

TABLE 35. COMPRESSIVE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi $\times 10^{-6}$) |
|---|---|---|---|---|
| D 17E | 600 | 0.5 | 186.98 | 24.31 |
| D 15E | | 0.5 | 188.24 | 24.31 |
| D 229E | | 0.5 | 186.67 | 24.47 |
| | | Average | 187.30 | 24.36 |
| D 214E | | 10 | 203.92 | 24.31 |
| D 26E | | 10 | 205.49 | 24.31 |
| D 110E | | 10 | 195.76 | 24.62 |
| | | Average | 201.72 | 24.41 |
| D 217E | | 100 | 202.98 | 24.78 |
| D 220E | | 100 | 203.92 | 24.47 |
| D 122E | | 100 | 205.49 | 24.47 |
| | | Average | 204.13 | 24.57 |
| D 16E | | 1000 | 218.04 | 26.19 |
| D 215E | | 1000 | 219.61 | 26.04 |
| D 21E | | 1000 | 216.47 | 25.88 |
| | | Average | 218.04 | 26.03 |
| D 225E | 800 | 0.5 | 180.08 | 23.53 |
| D 116E | | 0.5 | 171.92 | 23.69 |
| D 130E | | 0.5 | 175.06 | 23.69 |
| | | Average | 175.69 | 23.64 |
| D 224E | | 10 | 166.27 | 23.53 |
| D 113E | | 10 | 167.84 | 23.53 |
| D 27E | | 10 | 164.70 | 23.37 |
| | | Average | 166.27 | 23.48 |
| D 114E | | 100 | 170.98 | 23.84 |
| D 111E | | 100 | 172.55 | 23.84 |
| D 222E | | 100 | 172.55 | 24.00 |
| | | Average | 172.03 | 23.89 |
| D 228E | | 1000 | 177.25 | 23.53 |
| D 125E | | 1000 | 177.57 | 24.31 |
| D 36E | | 1000 | 178.82 | 24.31 |
| | | Average | 177.88 | 24.05 |

TABLE 35. COMPRESSIVE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Compressive Yield Strength (ksi) | Ec (psi X $10^{-6}$) |
|---|---|---|---|---|
| D 19E | 1000 | 0.5 | 101.96 | 19.61 |
| D 33E | | 0.5 | 94.12 | 19.61 |
| D 37E | | 0.5 | 109.80 | 20.39 |
| | | **Average** | 101.96 | 19.87 |
| D 39E | | 10 | 101.96 | 19.61 |
| D 12E | | 10 | 106.67 | 19.14 |
| D 310E | | 10 | 109.80 | 20.39 |
| | | **Average** | 106.14 | 19.78 |
| D 112E | | 100 | 88.78 | 20.39 |
| D 230E | | 100 | 90.98 | 18.82 |
| D 24E | | 100 | 92.16 | 19.58 |
| | | **Average** | 90.64 | 19.60 |
| D 124E | | 1000 | 91.29 | 18.66 |
| D 118E | | 1000 | 87.85 | 18.82 |
| D 11E | | 1000 | 81.57 | 18.51 |
| | | **Average** | 86.90 | 18.66 |

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| D 19C | Room | -- | 378.04 | 329.41 |
| D 226C | | -- | 372.16 | 332.94 |
| D 126C | | -- | 376.56 | 323.44 |
| | | Average | 375.58 | 326.56 |
| D 24C | 400 | 0.5 | 357.03 | 314.84 |
| D 211C | | 0.5 | 360.16 | 312.50 |
| D 11C | | 0.5 | 364.06 | 320.31 |
| | | Average | 360.41 | 315.88 |
| D 120C | | 10 | 356.25 | 310.16 |
| D 225C | | 10 | 357.81 | 306.25 |
| D 32C | | 10 | 353.13 | 314.84 |
| | | Average | 355.73 | 310.41 |
| D 114C | | 100 | 355.47 | 310.16 |
| D 29C | | 100 | 357.03 | 312.50 |
| D 222C | | 100 | 359.38 | 308.59 |
| | | Average | 357.29 | 310.41 |
| D 37C | | 1000 | 360.94 | 320.31 |
| D 34C | | 1000 | 357.81 | 306.25 |
| D 119C | | 1000 | 358.59 | 312.50 |
| | | Average | 359.11 | 313.02 |

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| D 117C | 600 | 0.5 | 340.63 | 295.31 |
| D 125C | | 0.5 | 335.16 | 296.09 |
| D 52C | | 0.5 | 344.53 | 293.75 |
| | | **Average** | 340.10 | 295.05 |
| D 510C | | 10 | 342.19 | 297.66 |
| D 111C | | 10 | 348.44 | 303.13 |
| D 28C | | 10 | 336.72 | 292.97 |
| | | **Average** | 342.45 | 297.92 |
| D 22C | | 100 | 342.97 | 295.31 |
| D 121C | | 100 | 345.31 | 300.78 |
| D 223C | | 100 | 342.19 | 290.63 |
| | | **Average** | 343.49 | 295.57 |
| D 36C | | 1000 | 342.97 | 296.88 |
| D 123C | | 1000 | 351.56 | 303.91 |
| D 57C | | 1000 | 346.09 | 300.00 |
| | | **Average** | 346.87 | 300.26 |
| D 218C | 800 | 0.5 | 290.63 | 257.03 |
| D 215C | | 0.5 | 292.97 | 250.78 |
| D 35C | | 0.5 | 289.06 | 263.67 |
| | | **Average** | 290.88 | 257.16 |
| D 112C | | 10 | 295.31 | 252.34 |
| D 16C | | 10 | 298.44 | 257.81 |
| D 12C | | 10 | 292.97 | 247.66 |
| | | **Average** | 295.57 | 252.60 |
| D 53C | | 100 | 289.84 | 230.47 |
| D 23C | | 100 | 293.75 | 229.69 |
| D 59C | | 100 | 288.28 | 233.59 |
| | | **Average** | 290.62 | 231.25 |
| D 118C | | 1000 | 242.97 | 201.56 |
| D 219C | | 1000 | 238.28 | 189.84 |
| D 26C | | 1000 | 239.84 | 195.31 |
| | | **Average** | 240.36 | 195.57 |

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont d)

a. e/D = 1.5

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| D 25C | 1000 | 0.5 | 180.47 | 155.47 |
| D 216C | | 0.5 | 186.72 | 153.13 |
| D 31C | | 0.5 | 175.00 | 157.81 |
| | | Average | 180.73 | 155.47 |
| D 13C | | 10 | 165.63 | 143.75 |
| D 27C | | 10 | 164.84 | 147.66 |
| D 124C | | 10 | 164.06 | 145.31 |
| | | Average | 164.84 | 145.57 |
| D 212C | | 100 | 141.41 | 125.00 |
| D 54C | | 100 | 144.53 | 121.09 |
| D 18C | | 100 | 139.84 | 129.69 |
| | | Average | 141.92 | 125.26 |
| D 122C | | 1000 | 120.31 | 100.00 |
| D 58C | | 1000 | 121.88 | 96.09 |
| D 17C | | 1000 | 119.92 | 104.69 |
| | | Average | 120.70 | 100.26 |

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

b. c/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| D 16D | Room | -- | 470.31 | 423.44 |
| D 222D | | -- | 475.78 | 426.56 |
| D 220D | | -- | 469.97 | 421.88 |
| | | Average | 472.02 | 423.96 |
| D 56D | 400 | 0.5 | 442.19 | 353.52 |
| D 510D | | 0.5 | 439.06 | 361.72 |
| D 24D | | 0.5 | 441.41 | 361.72 |
| | | Average | 440.88 | 358.98 |
| D 38D | | 10 | 439.84 | 360.16 |
| D 216D | | 10 | 436.72 | 355.47 |
| D 59D | | 10 | 429.69 | 351.56 |
| | | Average | 435.41 | 355.73 |
| D 33D | | 100 | 435.16 | 353.91 |
| D 124D | | 100 | 435.16 | 353.81 |
| D 118D | | 100 | 439.84 | 357.81 |
| | | Average | 436.72 | 355.17 |
| D 36D | | 1000 | 425.00 | 350.00 |
| D 125D | | 1000 | 425.78 | 352.34 |
| D 219D | | 1000 | 424.61 | 349.22 |
| | | Average | 425.13 | 350.52 |

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| D 54D | 600 | 0.5 | 415.69 | 337.25 |
| D 29D | | 0.5 | 416.41 | 339.84 |
| D 55D | | 0.5 | 418.75 | 342.19 |
| | | **Average** | 416.95 | 339.76 |
| D 224D | | 10 | 417.97 | 330.08 |
| D 32D | | 10 | 417.97 | 345.31 |
| D 211D | | 10 | 416.80 | 344.53 |
| | | **Average** | 417.58 | 339.97 |
| D 221D | | 100 | 417.97 | 339.84 |
| D 121D | | 100 | 414.06 | 335.94 |
| D 15D | | 100 | 422.66 | 342.97 |
| | | **Average** | 418.23 | 339.58 |
| D 21D | | 1000 | 426.67 | 347.45 |
| D 117D | | 1000 | 421.09 | 348.44 |
| D 225D | | 1000 | 421.88 | 346.88 |
| | | **Average** | 423.21 | 347.59 |
| D 18D | 800 | 0.5 | 360.16 | 317.97 |
| D 223D | | 0.5 | 360.16 | 314.84 |
| D 53D | | 0.5 | 366.41 | 320.31 |
| | | **Average** | 362.24 | 317.70 |
| D 12D | | 10 | 360.16 | 310.94 |
| D 13D | | 10 | 363.28 | 314.06 |
| D 57D | | 10 | 367.97 | 316.41 |
| | | **Average** | 363.80 | 313.80 |
| D 201D | | 100 | 338.28 | 304.69 |
| D 58D | | 100 | 339.84 | 305.47 |
| D 115D | | 100 | 342.19 | 310.16 |
| | | **Average** | 340.10 | 306.77 |
| D 11D | | 1000 | 328.13 | 296.88 |
| D 19D | | 1000 | 324.22 | 307.81 |
| D 23D | | 1000 | 325.00 | 295.31 |
| | | **Average** | 325.78 | 300.00 |

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. e/D = 2.0

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Bearing Strength (ksi) | Bearing Yield Strength (ksi) |
|---|---|---|---|---|
| D 14D | 1000 | 0.5 | 220.31 | 189.84 |
| D 120D | | 0.5 | 221.88 | 196.88 |
| D 27D | | 0.5 | 210.94 | 187.50 |
| | | Average | 217.71 | 191.40 |
| D 123D | | 10 | 189.84 | 160.16 |
| D 17D | | 10 | 187.50 | 157.03 |
| D 113D | | 10 | 190.63 | 153.91 |
| | | Average | 189.32 | 157.03 |
| D 122D | | 100 | 160.16 | 130.47 |
| D 119D | | 100 | 164.06 | 134.77 |
| D 34D | | 100 | 157.03 | 126.56 |
| | | Average | 160.41 | 130.60 |
| D 31D | | 1000 | 137.50 | 120.31 |
| D 215D | | 1000 | 138.28 | 118.75 |
| D 214D | | 1000 | 140.63 | 120.31 |
| | | Average | 138.80 | 119.79 |

TABLE 37. SHEAR PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| D 69F | Room | -- | 90.65 |
| D 38F | | -- | 88.79 |
| D 54F | | -- | 87.85 |
| | | Average | 89.10 |
| D 510F | 400 | 0.5 | 84.11 |
| D 37F | | 0.5 | 84.11 |
| D 11F | | 0.5 | 81.31 |
| | | Average | 83.18 |
| D 68F | | 10 | 83.18 |
| D 313F | | 10 | 83.18 |
| D 56F | | 10 | 84.11 |
| | | Average | 83.49 |
| D 57F | | 100 | 83.18 |
| D 514F | | 100 | 82.24 |
| D 42F | | 100 | 82.24 |
| | | Average | 82.55 |
| D 32F | | 1000 | 82.24 |
| D 312F | | 1000 | 81.78 |
| D 47F | | 1000 | 82.24 |
| | | Average | 82.09 |

TABLE 37. SHEAR PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| D 63F | 600 | 0.5 | 74.77 |
| D 67F | | 0.5 | 77.57 |
| D 53F | | 0.5 | 77.10 |
| | | Average | 76.48 |
| D 612F | | 10 | 77.57 |
| D 22F | | 10 | 79.44 |
| D 34F | | 10 | 78.50 |
| | | Average | 78.50 |
| D 12F | | 100 | 81.31 |
| D 13F | | 100 | 79.44 |
| D 36F | | 100 | 80.37 |
| | | Average | 80.37 |
| D 21F | | 1000 | 81.31 |
| D 59F | | 1000 | 82.24 |
| D 611F | | 1000 | 83.18 |
| | | Average | 82.24 |
| D 412F | 800 | 0.5 | 74.77 |
| D 33F | | 0.5 | 78.51 |
| D 43F | | 0.5 | 72.90 |
| | | Average | 75.39 |
| D 311F | | 10 | 74.77 |
| D 35F | | 10 | 75.70 |
| D 415F | | 10 | 75.70 |
| | | Average | 75.39 |
| D 310F | | 100 | 70.09 |
| D 411F | | 100 | 70.09 |
| D 513F | | 100 | 71.03 |
| | | Average | 70.40 |
| D 615F | | 1000 | 63.08 |
| D 414F | | 1000 | 63.55 |
| D 46F | | 1000 | 61.68 |
| | | Average | 62.77 |

TABLE 37. SHEAR PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

| Specimen Number | Test Temperature (°F) | Exposure Time (hr) | Ultimate Shear Strength (ksi) |
|---|---|---|---|
| D 66F | 1000 | 0.5 | 40.19 |
| D 614F | | 0.5 | 43.93 |
| D 48F | | 0.5 | 42.99 |
| | | Average | 42.37 |
| D 52F | | 10 | 39.72 |
| D 23F | | 10 | 34.58 |
| D 61F | | 10 | 32.71 |
| | | Average | 35.67 |
| D 51F | | 100 | 33.64 |
| D 44F | | 100 | 39.25 |
| D 316F | | 100 | 32.24 |
| | | Average | 35.04 |
| D 31F | | 1000 | 27.10 |
| D 65F | | 1000 | 29.91 |
| D 24F | | 1000 | 28.97 |
| | | Average | 28.66 |

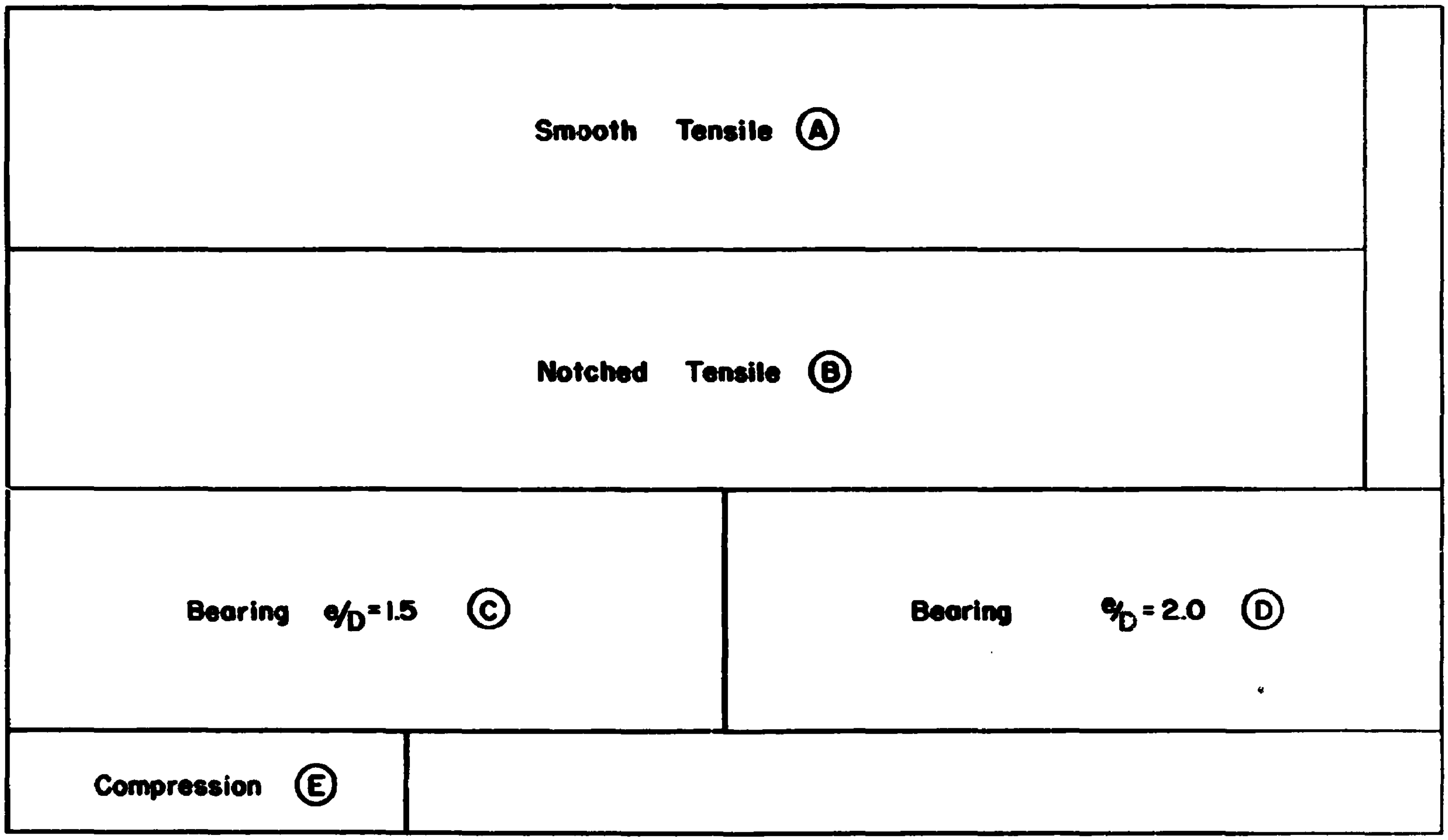


FIGURE 1. CUTTING PATTERN FOR SHEET SPECIMENS - ALL MATERIALS EXCEPT 301 STAINLESS STEEL

## Identification Code

| | | |
|---|---|---|
| First Part, a letter | = | Material - B = Ph15-7 Mo, D = 301 Stainless Steel, E = AM 355, F = René 41, and G = N-155 (Multimet) |
| Second Part, a number | = | Location in sheet (first digit = longitudinal position and second digit = transverse position) |
| Third Part, a letter | = | Individual specimen identification |

Thus Specimen E32A = an AM 355 smooth tensile specimen from Group 32

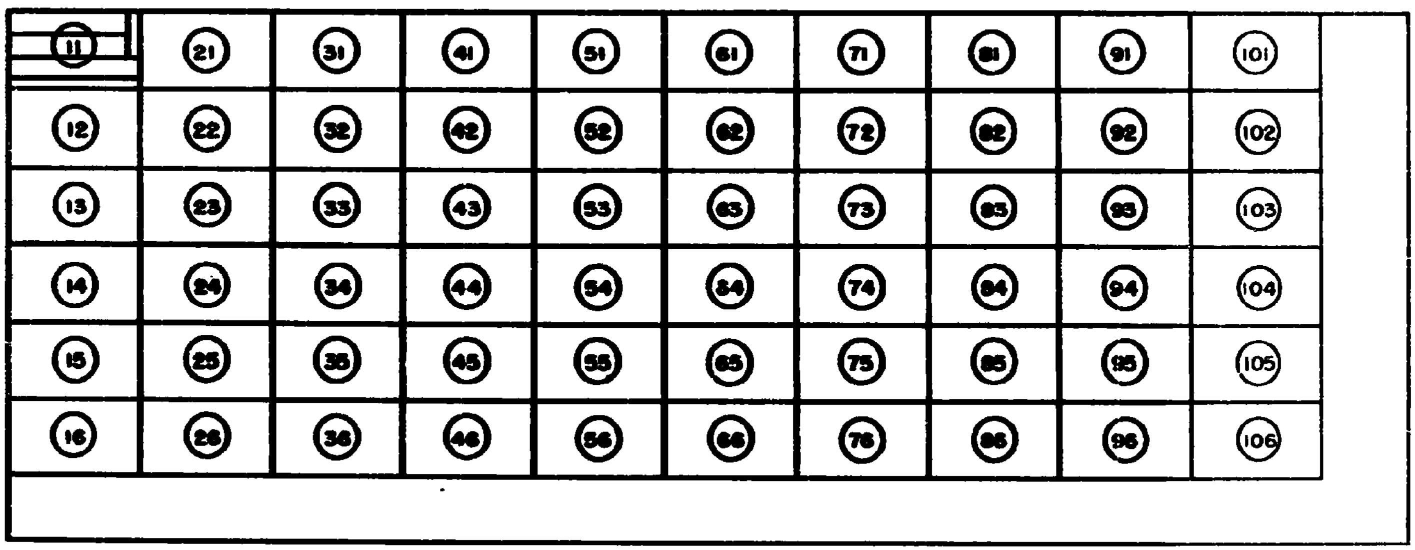


FIGURE 2. PATTERN AND IDENTIFICATION CODE FOR SHEARING BLANKS FROM 3' × 8' SHEET

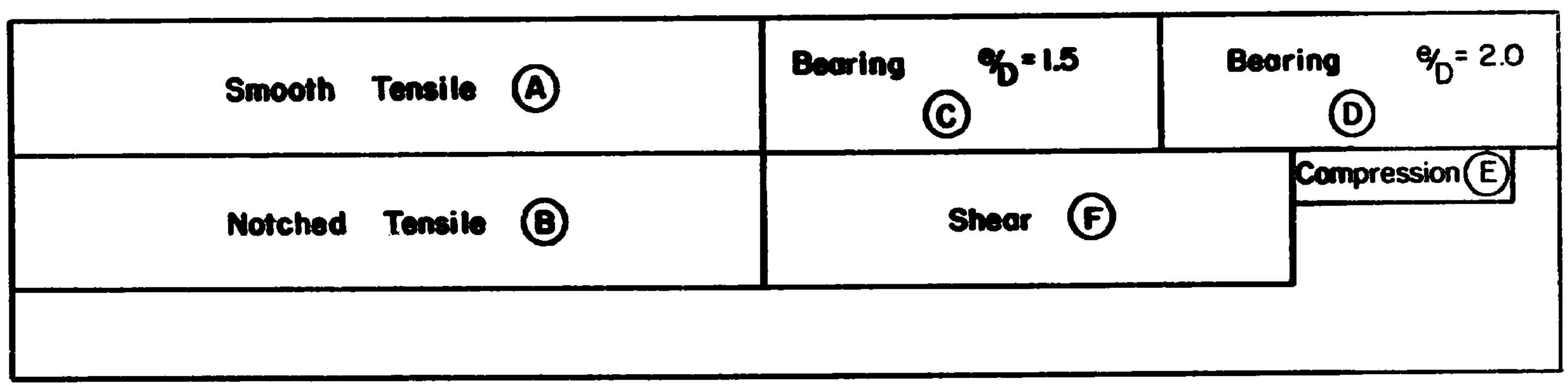


FIGURE 3. CUTTING PATTERN FOR 301 STAINLESS STEEL SHEET SPECIMEN

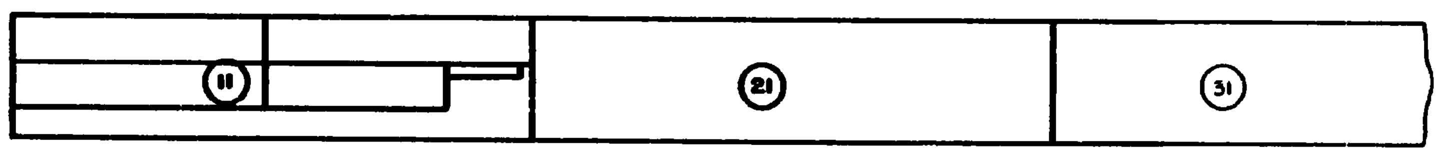


FIGURE 4. PATTERN FOR SHEARING SPECIMEN BLANKS FROM 4" × 96" SHEET FOR 301 STAINLESS STEEL

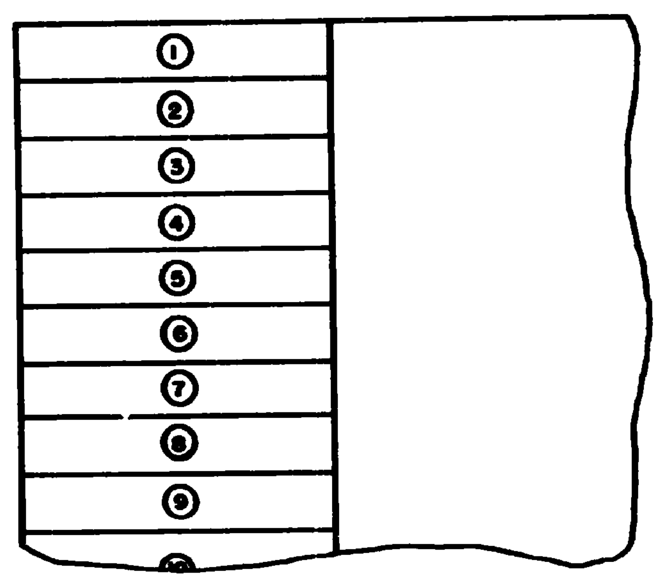


FIGURE 5. PATTERN FOR CUTTING SPECIMEN BLANKS FOR PIN SHEAR SPECIMENS FROM 1/4" PLATE - ALL MATERIALS EXCEPT 301 STAINLESS STEEL

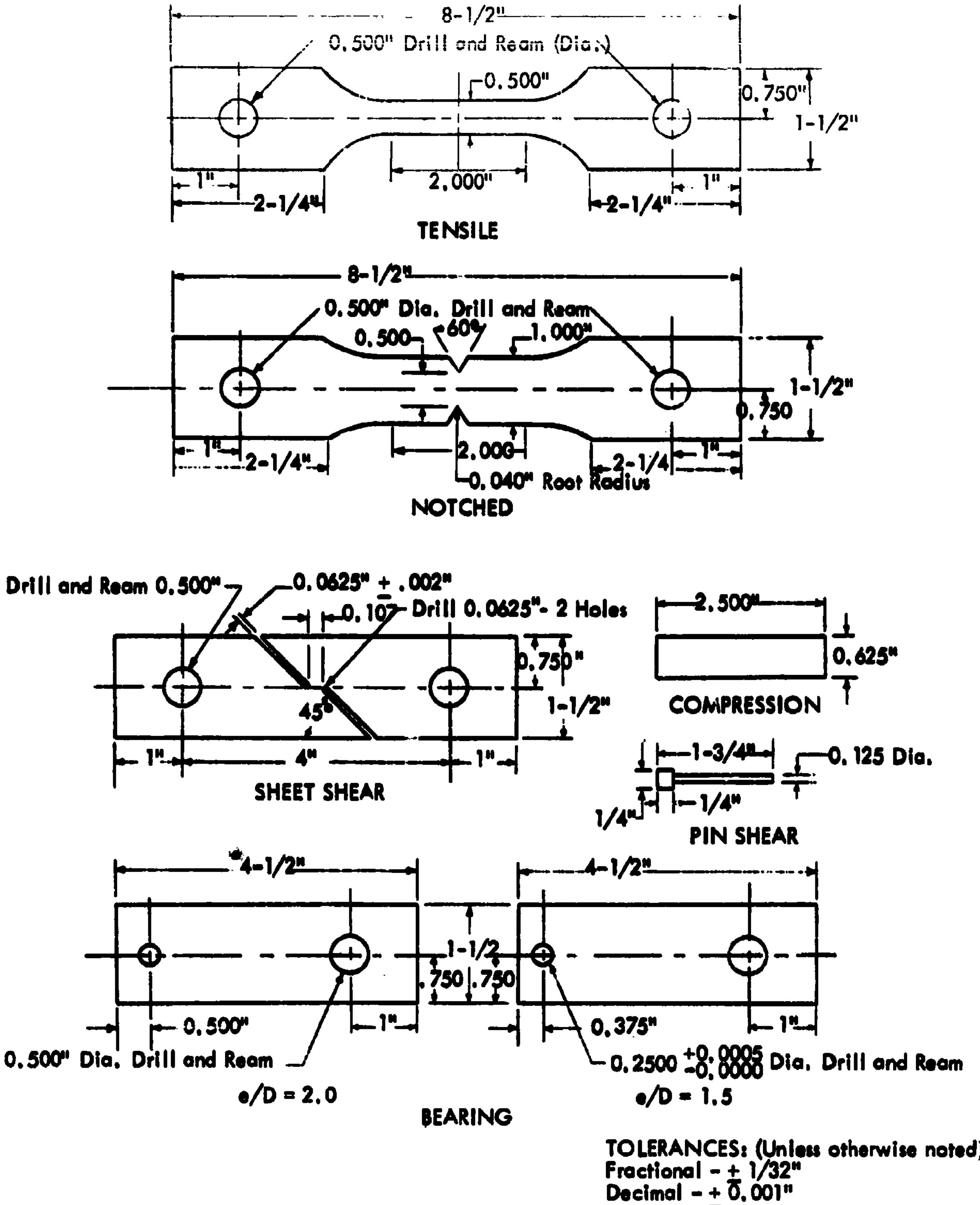


FIGURE 6. TEST SPECIMENS

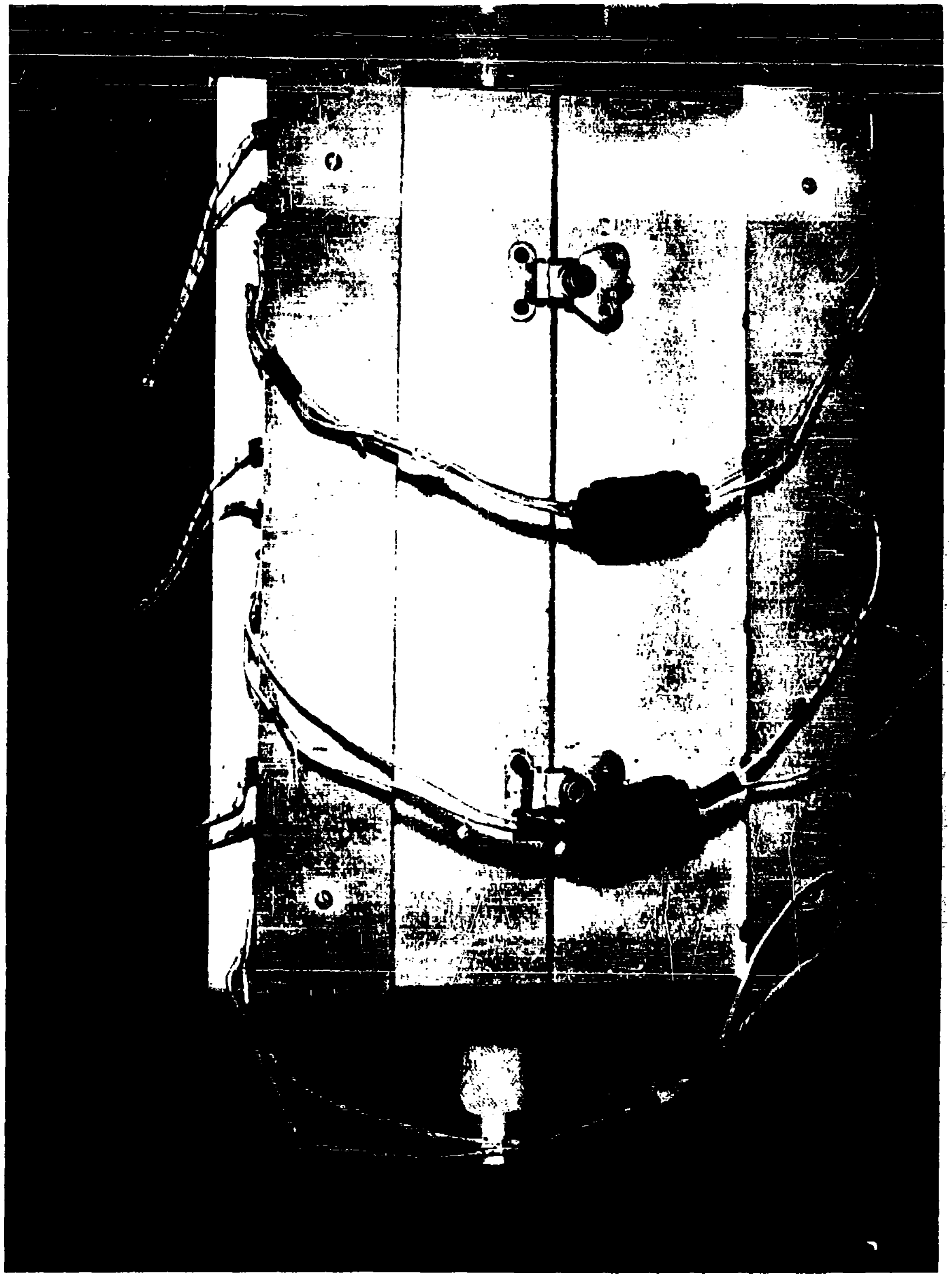

FIGURE 7. TEST FURNACE INSTALLED IN 200, 000 LB UNIVERSAL TESTING MACHINE

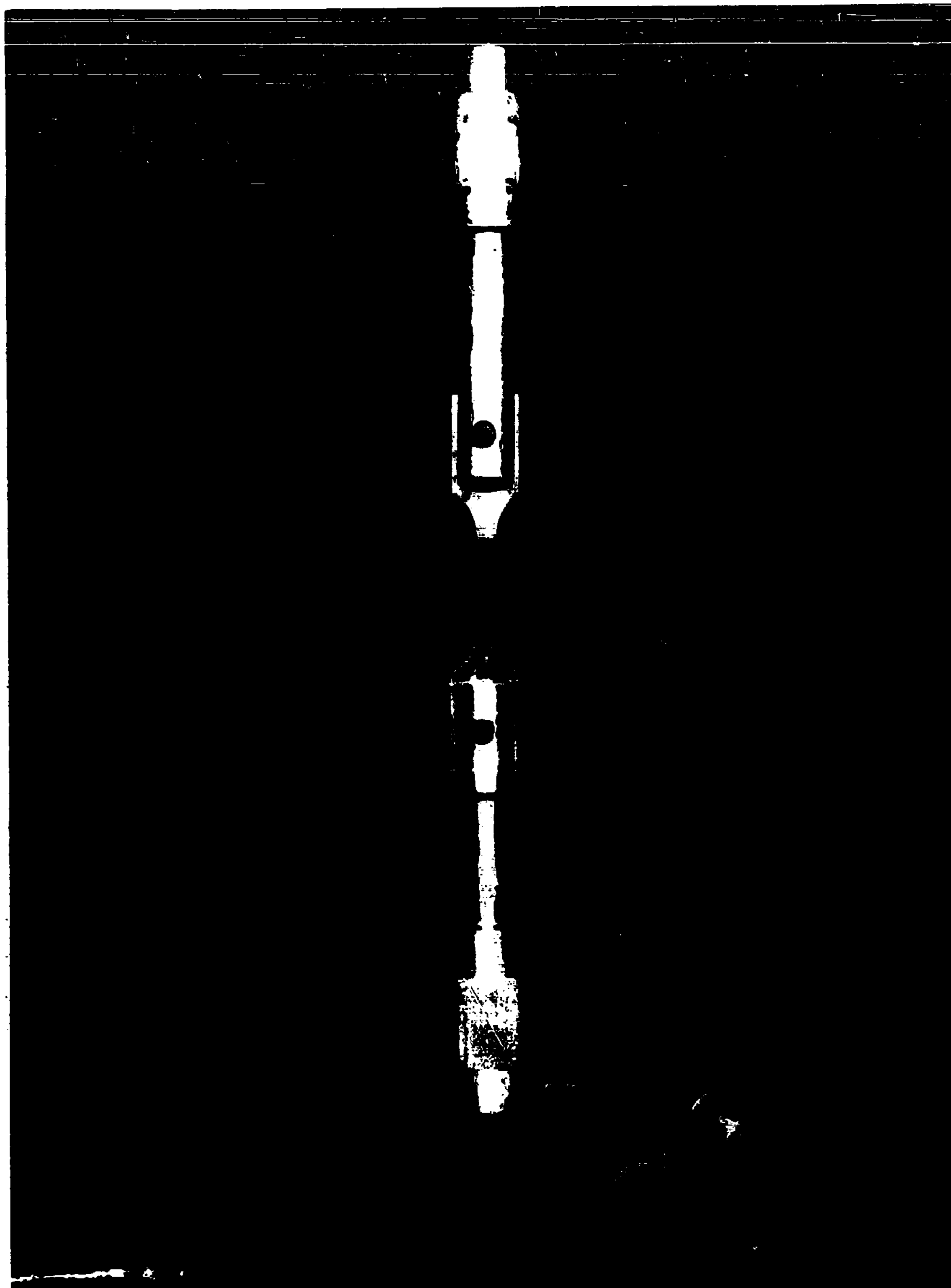

FIGURE 8. TUCKETMAN OPTICAL STRAIN GAGE ON TENSILE SPECIMEN

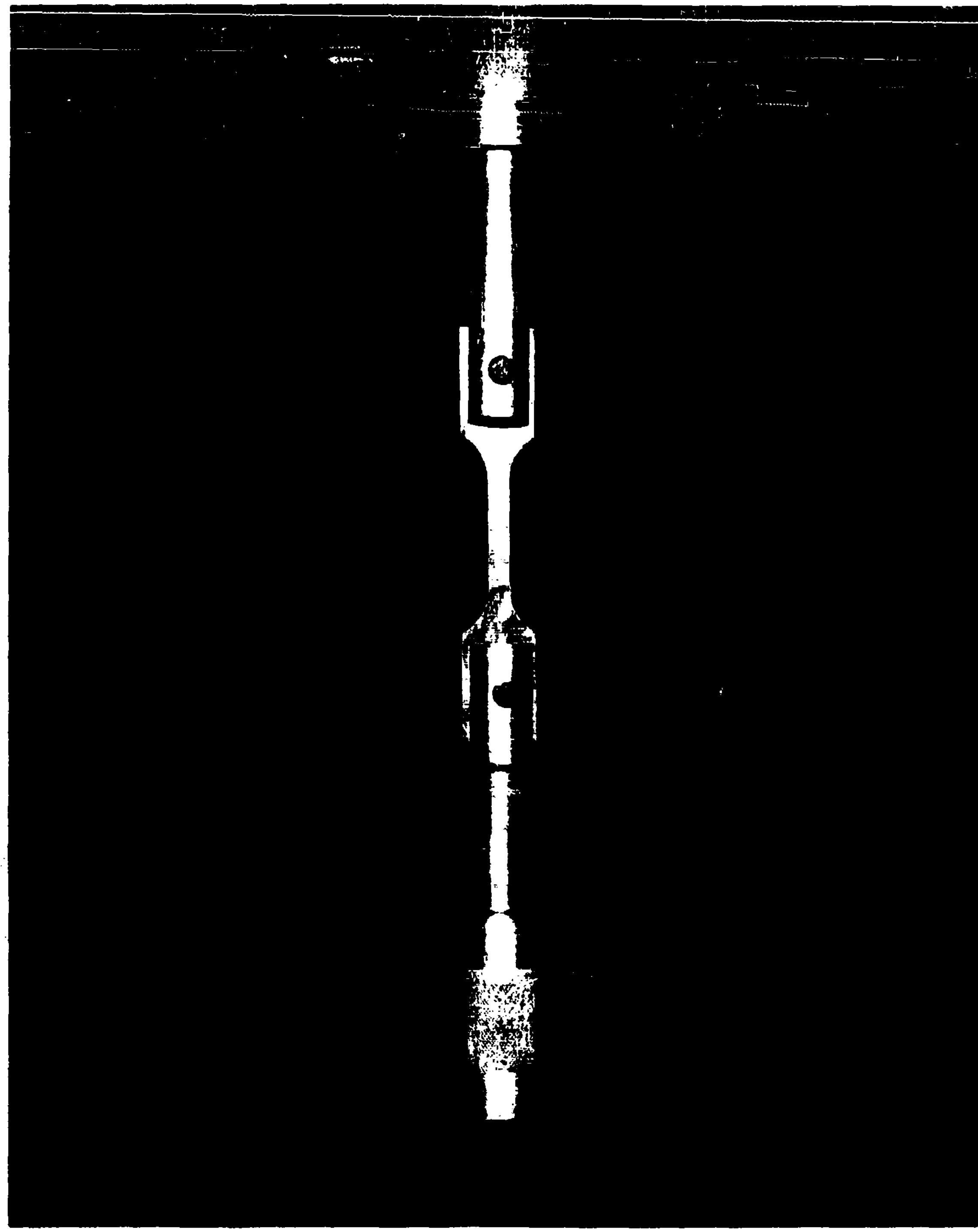

FIGURE 9. TENSILE TEST APPARATUS

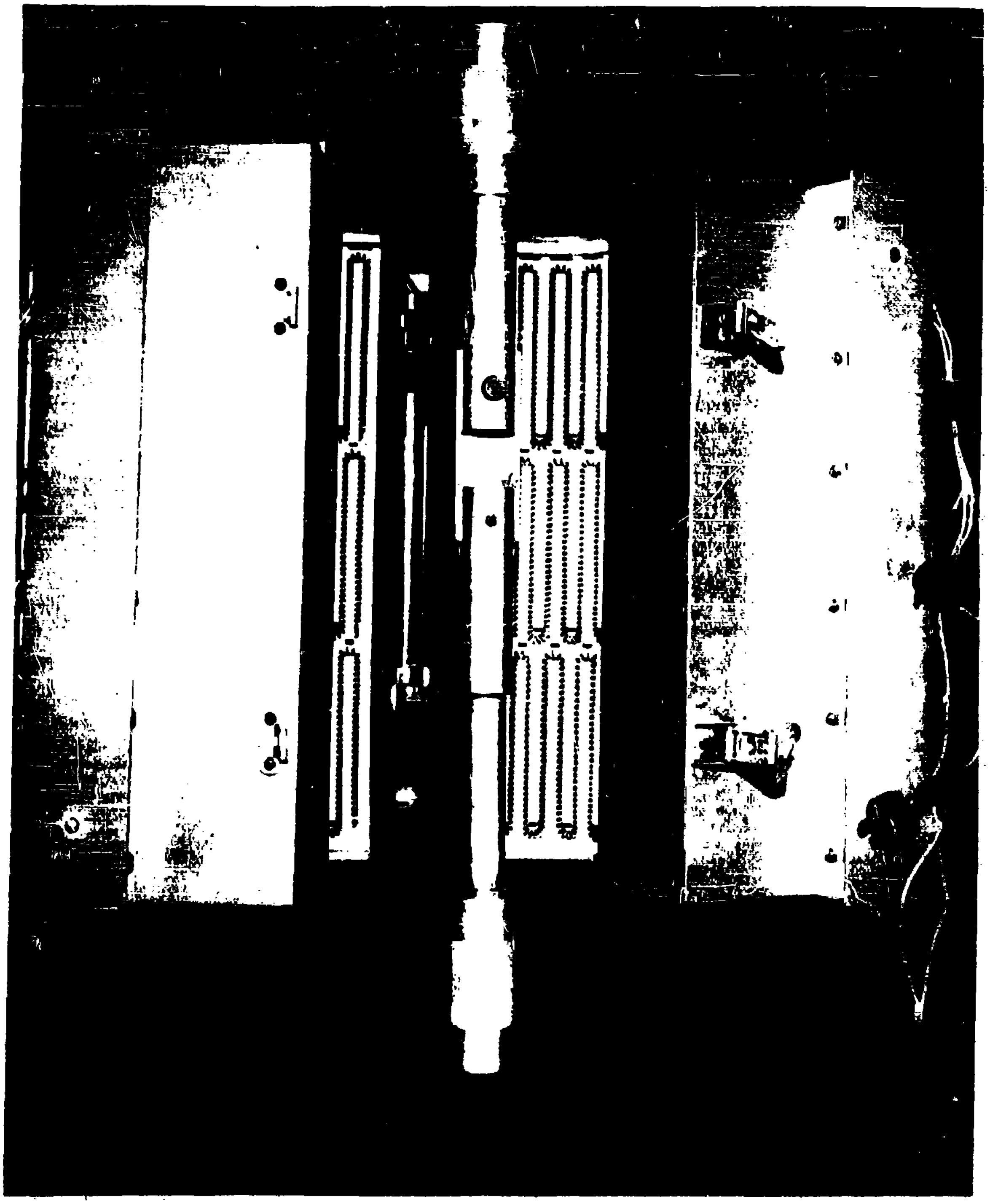

FIGURE 10. BEARING TEST APPARATUS IN TEST FURNACE

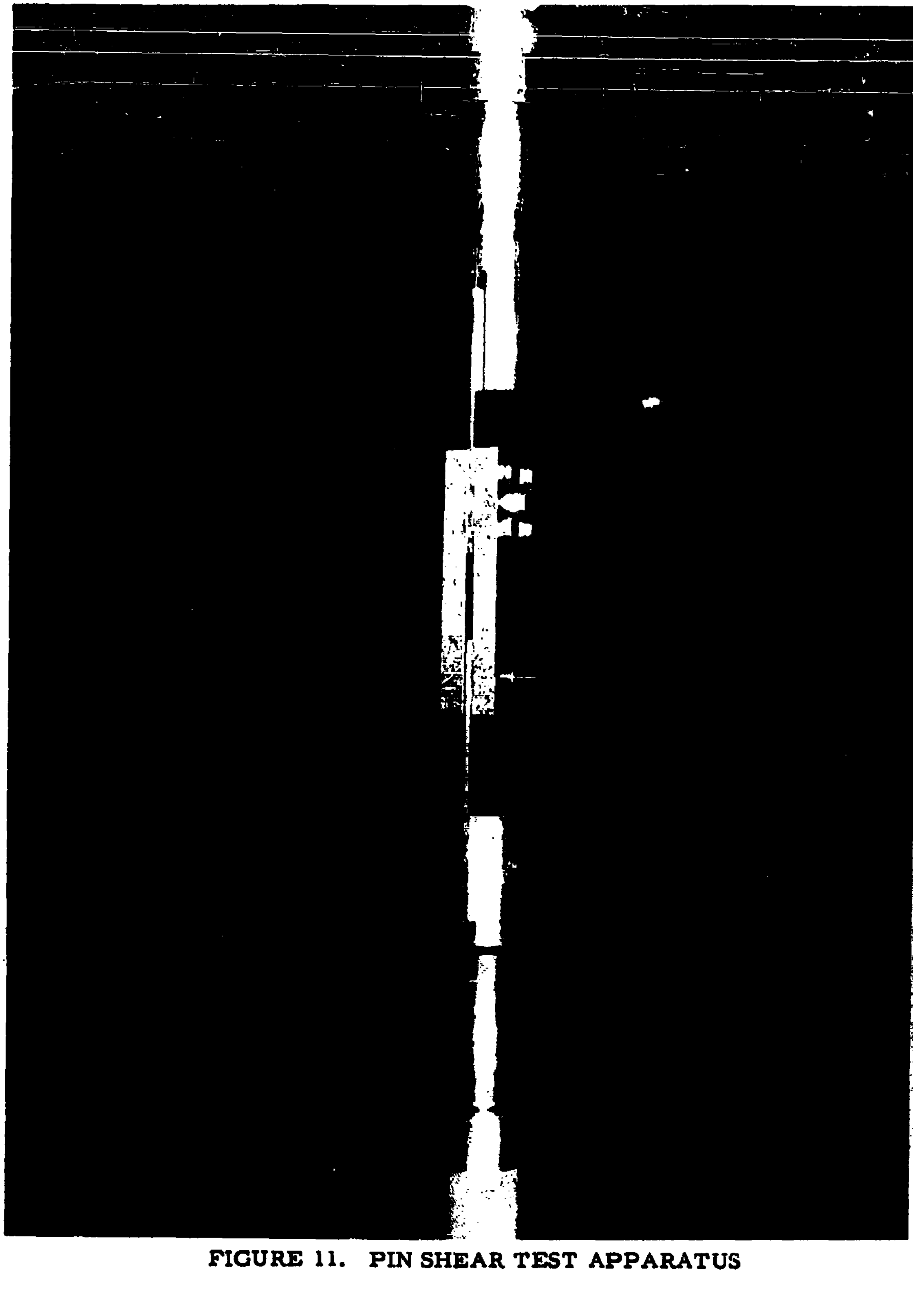

FIGURE 11. PIN SHEAR TEST APPARATUS

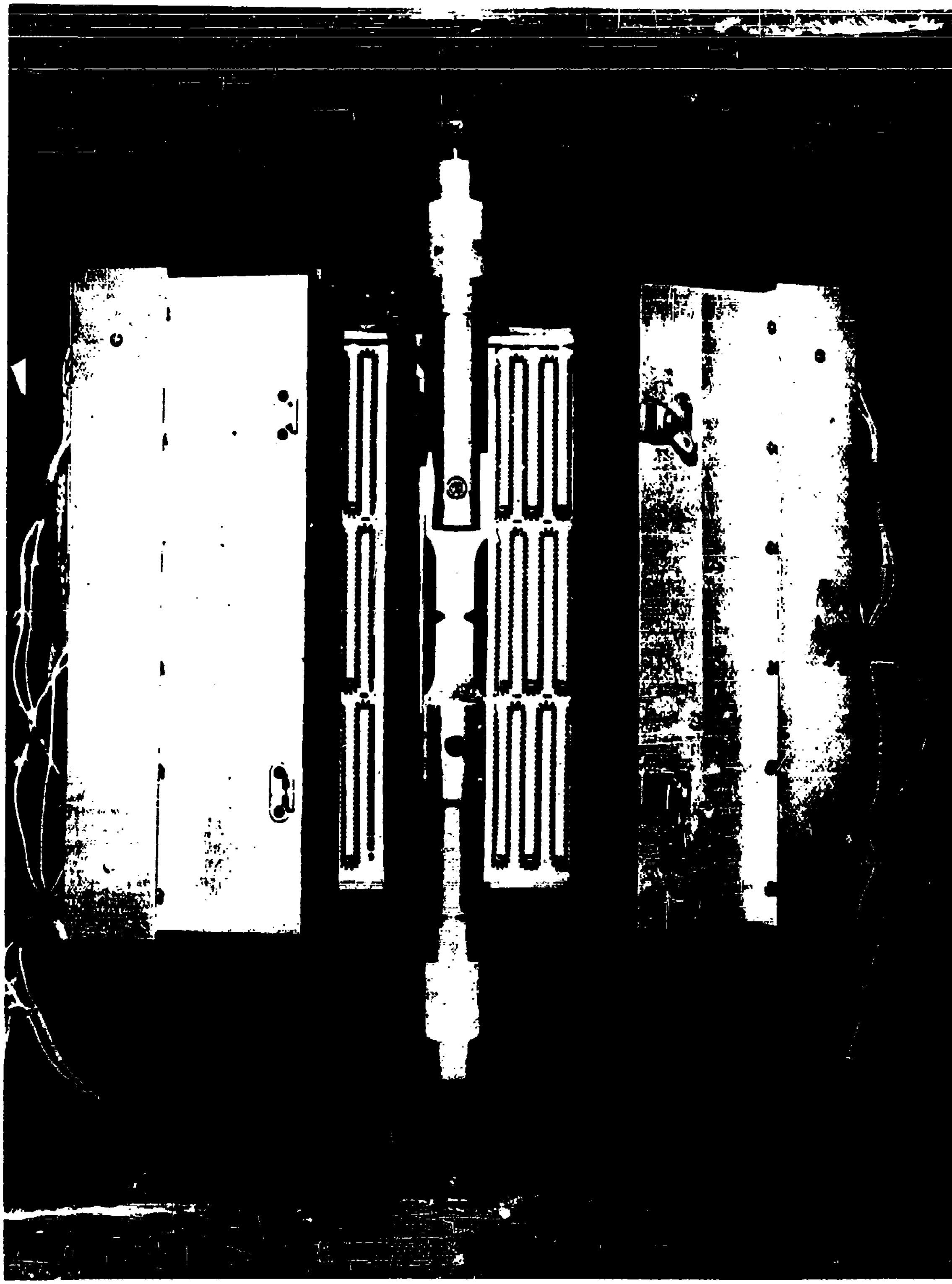

FIGURE 12. NOTCHED TENSILE TEST APPARATUS IN TEST FURNACE

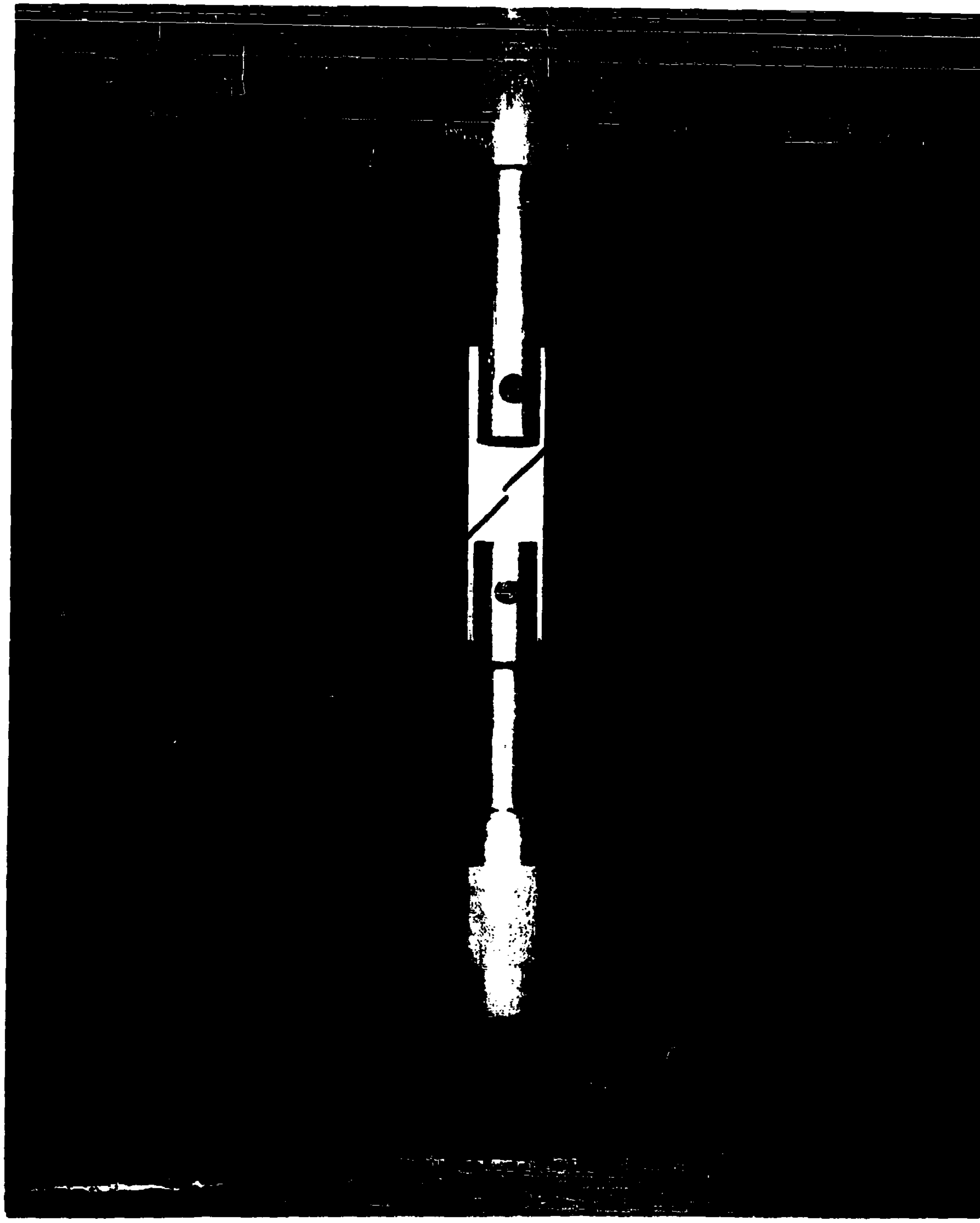

FIGURE 13. SHEET SHEAR TEST APPARATUS

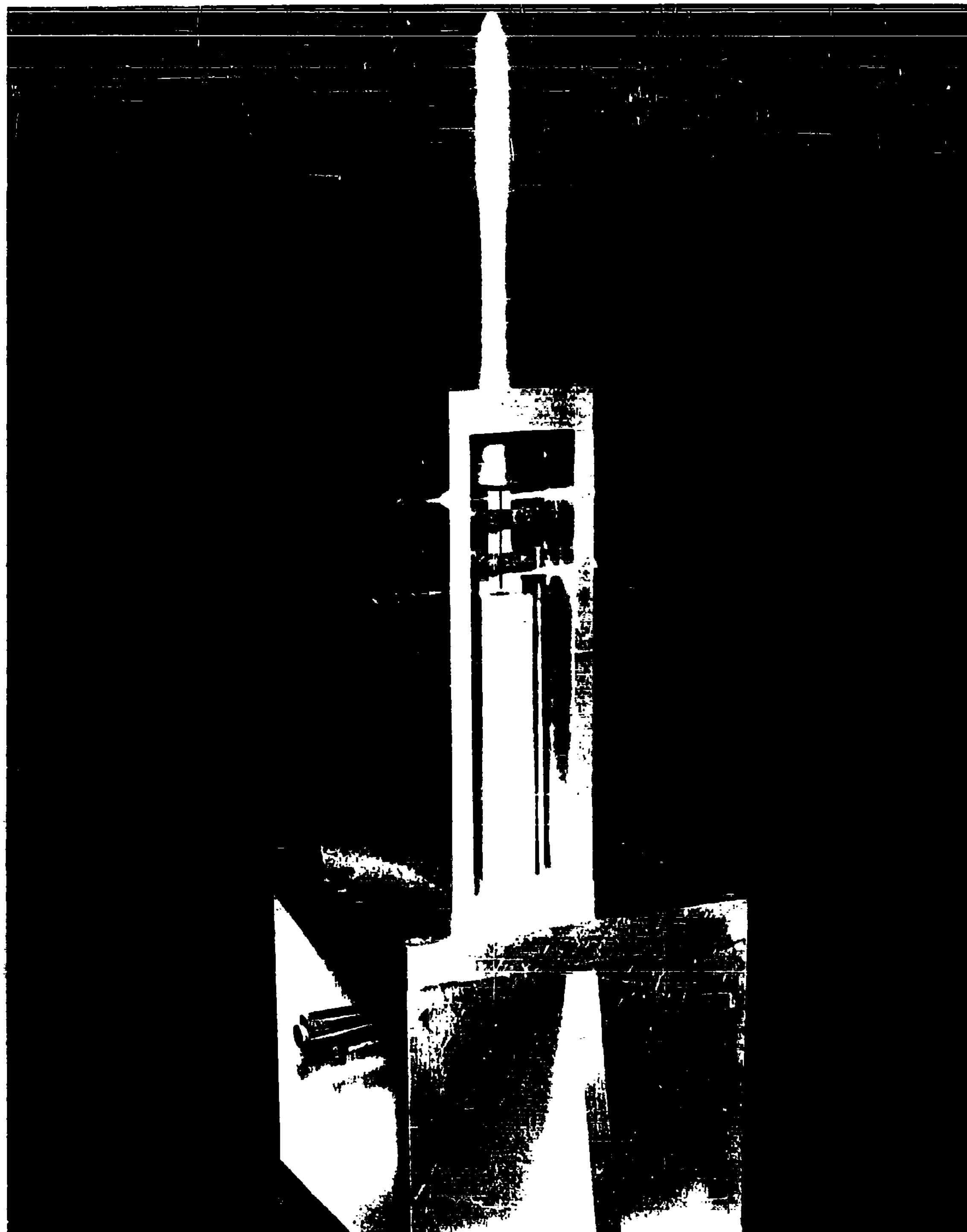

FIGURE 14. COMPRESSION JIG WITH MICROFORMER ATTACHED

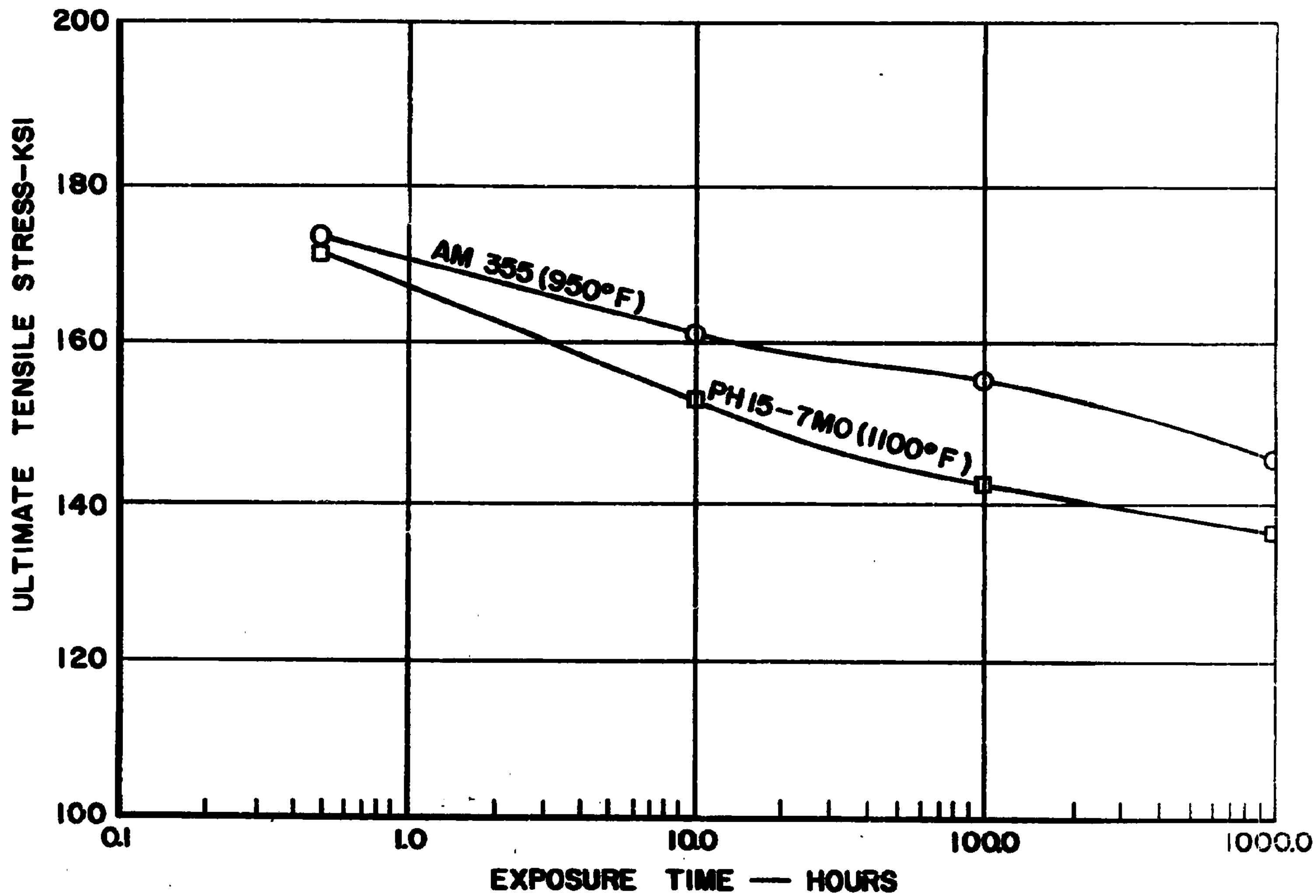


FIGURE 15. ROOM TEMPERATURE TENSILE PROPERTIES OF Ph15-7Mo AND AM 355 AFTER EXPOSURE ABOVE TEMPERING TEMPERATURES

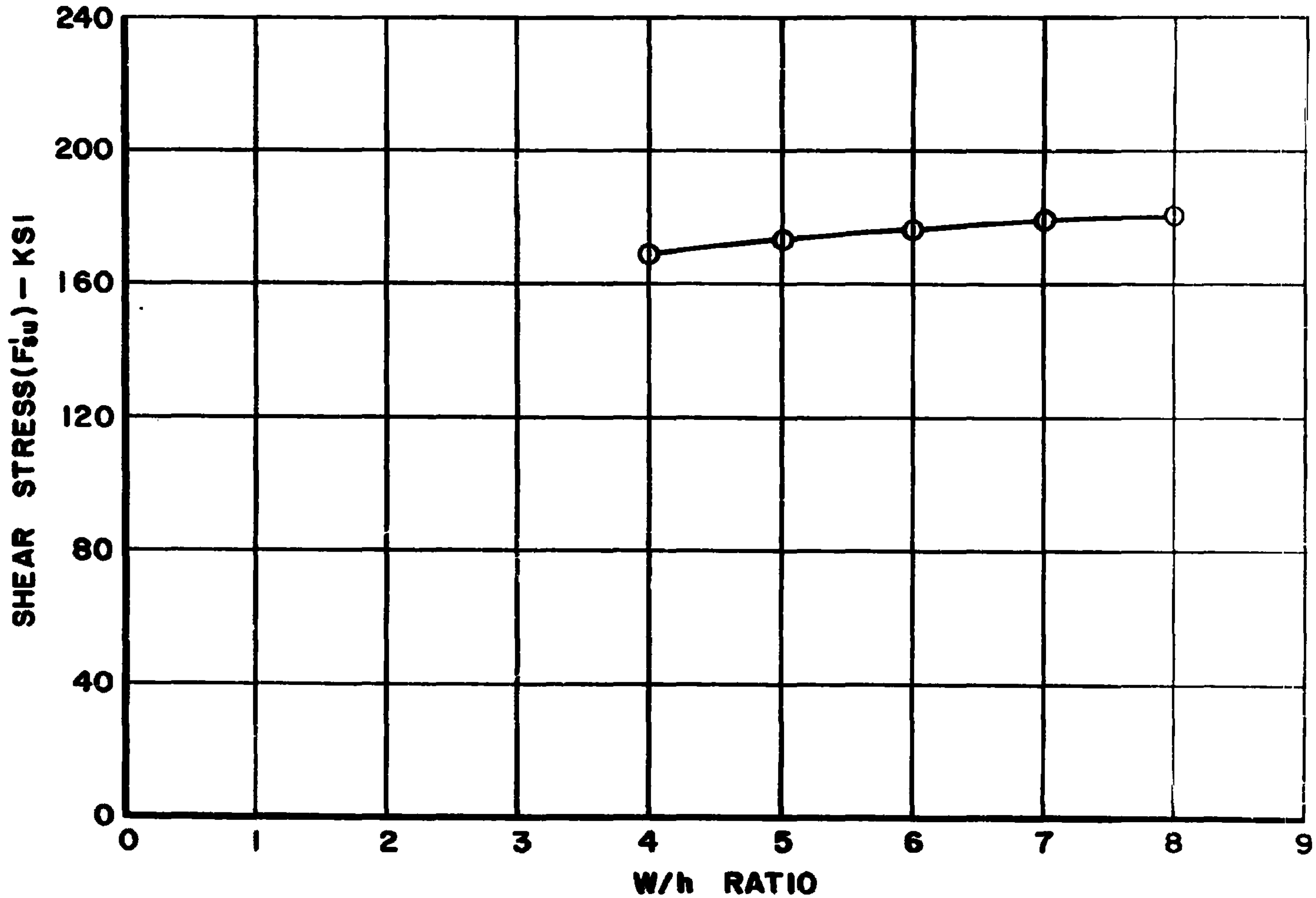


FIGURE 16. ROOM TEMPERATURE SHEET SHEAR STRESS OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS W/h RATIOS

# APPENDIX I

## SUMMARY OF ROOM TEMPERATURE PROPERTIES OF Ph15-7Mo

**Form: 0.050 Inch Sheet**

**Condition: TH 1050**

**Properties:**

| | | | | |
|---|---|---|---|---|
| Ultimate Tensile Strength | - | $F_{tu}$ | = | 195,590 psi |
| Tensile Yield Strength | - | $F_{ty}$ | = | 176,830 psi |
| Modulus of Elasticity | - | $E$ | = | $28.57 \times 10^6$ psi |
| Percent of Elongation in 2 inches | | | = | 8.6 |
| Notched Tensile Strength | - | $F_{tu}$ | = | 213,360 psi |
| Compressive Yield Strength | - | $F_{cy}$ | = | 205,050 psi |
| Compressive Modulus of Elasticity | - | $E_c$ | = | $29.61 \times 10^6$ psi |
| Ultimate Bearing Strength | | | | |
| (e/D = 1.5) | - | $F_{bru}$ | = | 316,780 psi |
| (e/D = 2.0) | - | $F_{bru}$ | = | 399,730 psi |
| Bearing Yield Strength | | | | |
| (e/D = 1.5) | - | $F_{bry}$ | = | 271,400 psi |
| (e/D = 2.0) | - | $F_{bry}$ | = | 323,470 psi |
| Ultimate Shear Strength | - | $F_{su}$ | = | 146,120 psi |

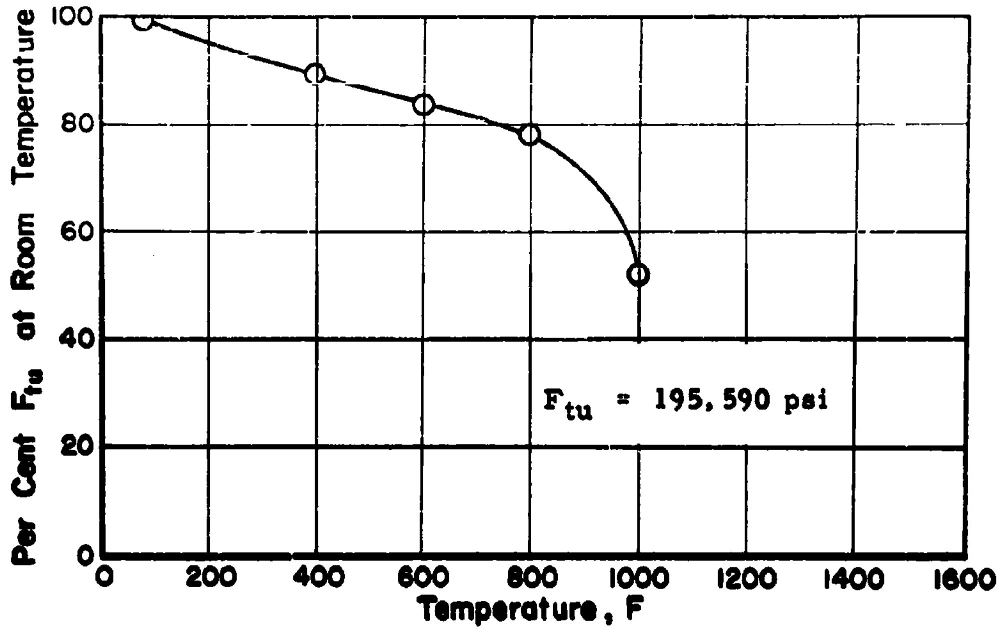


FIGURE 17. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

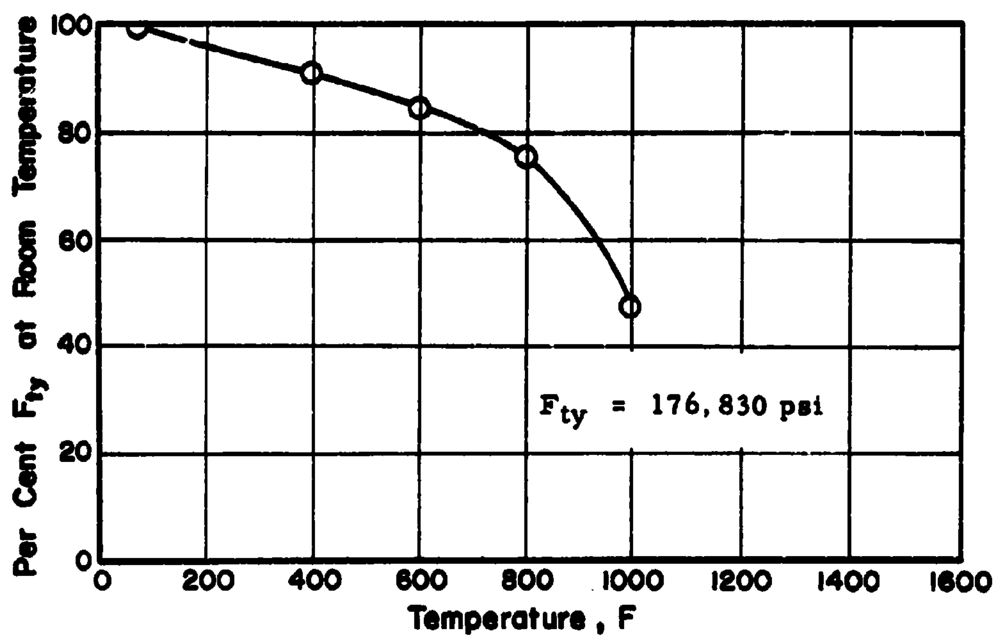


FIGURE 18. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

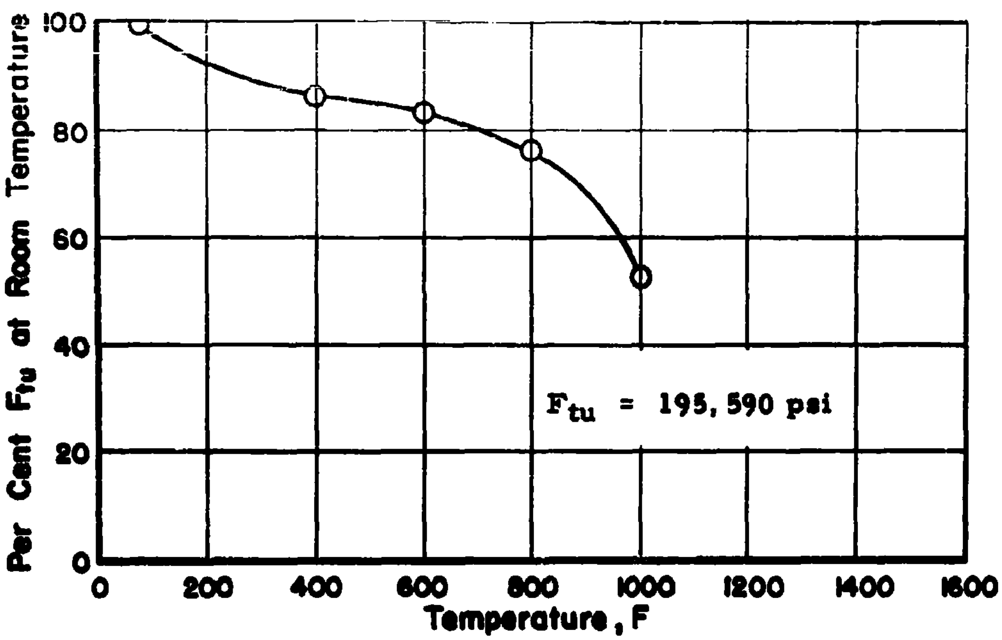


FIGURE 19. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

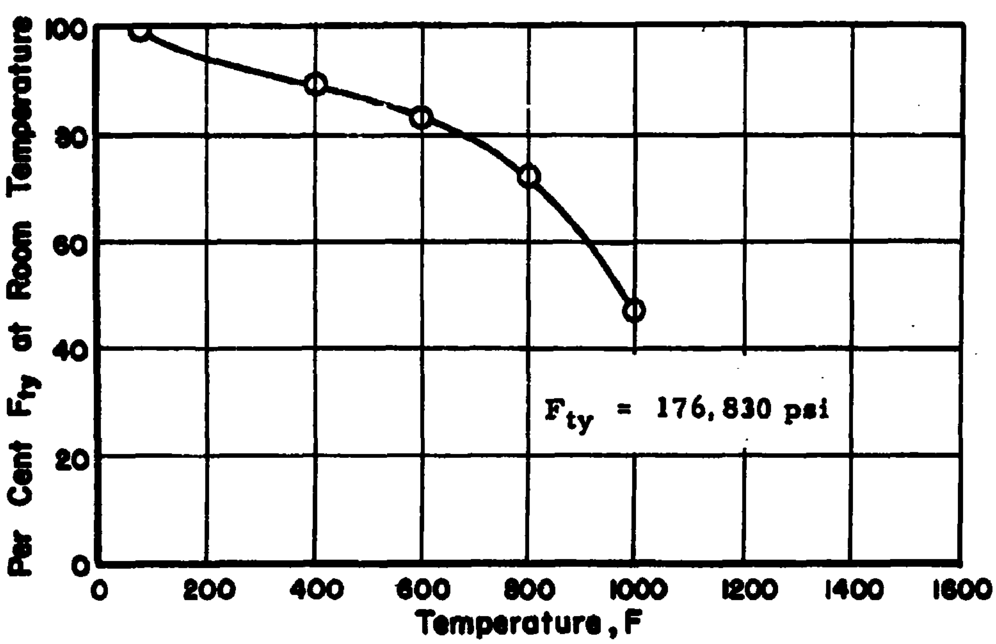


FIGURE 20. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

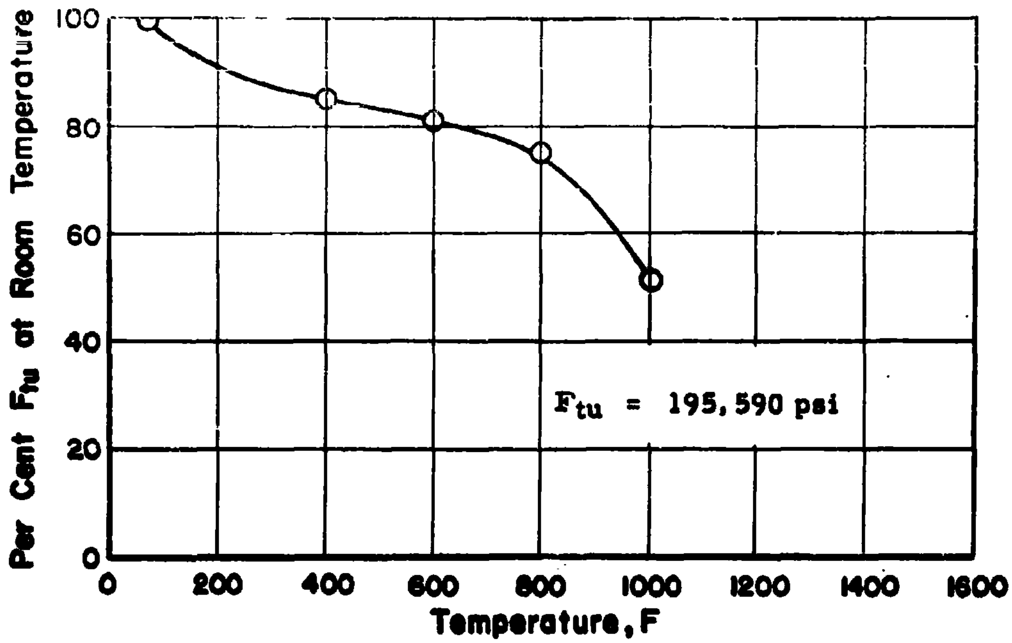


FIGURE 21. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

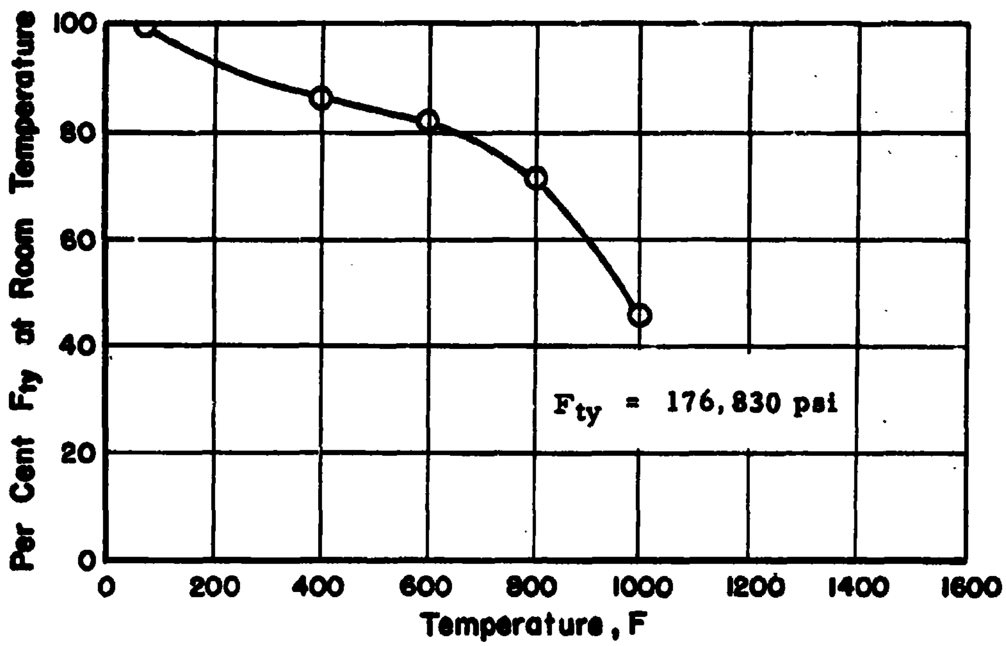


FIGURE 22. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

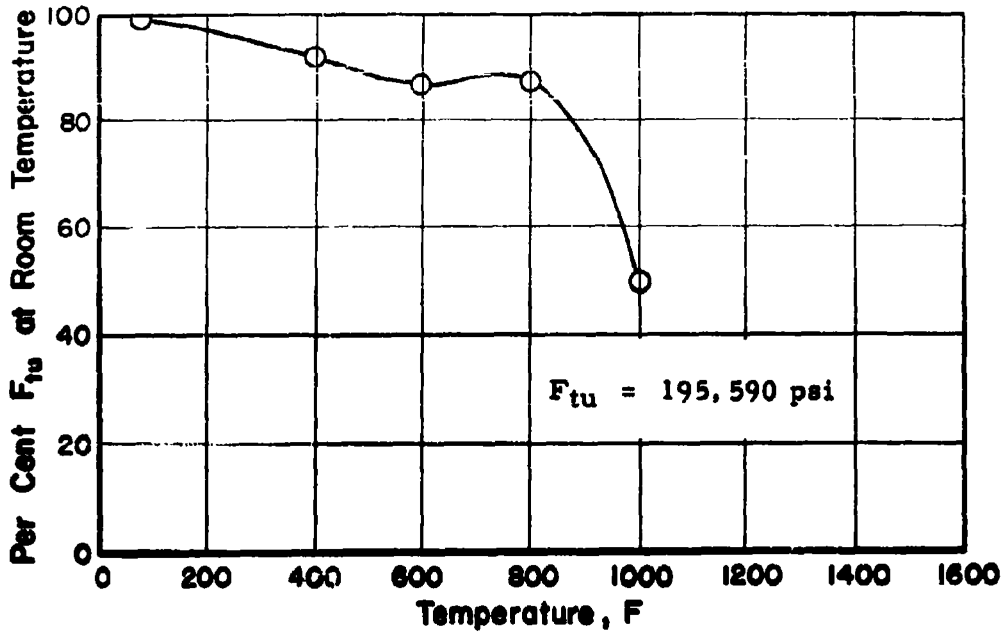


FIGURE 23. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

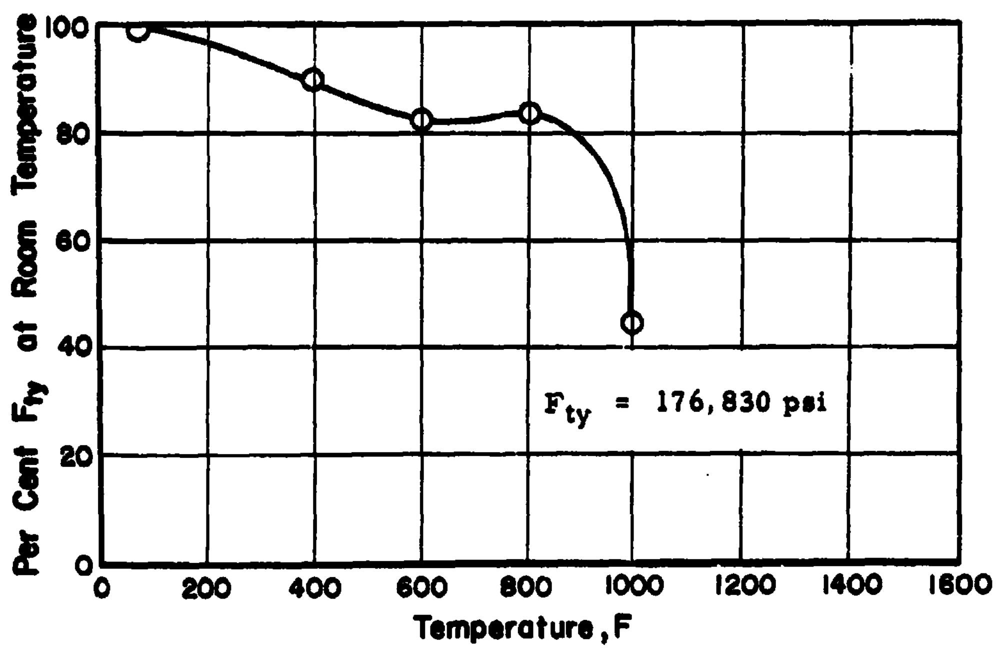


FIGURE 24. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

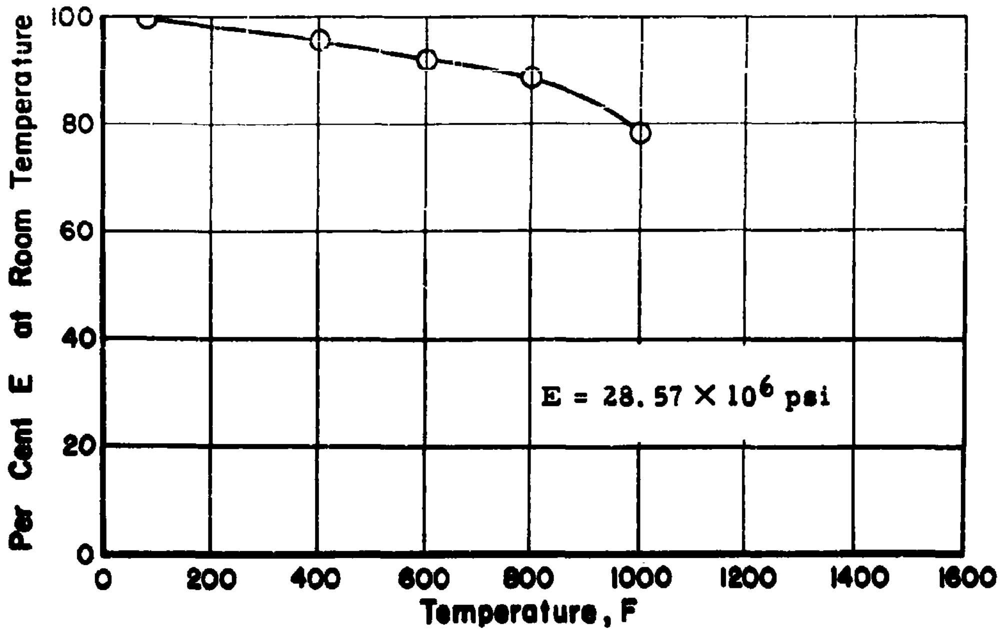


FIGURE 25. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF Ph15-7Mo EXPOSED 0.5 HOURS

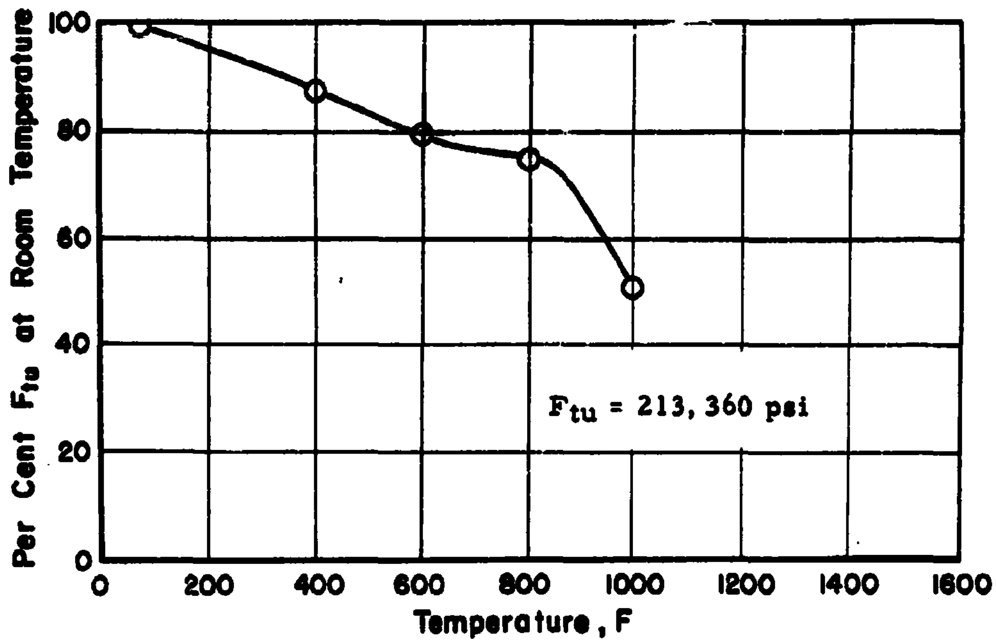


FIGURE 26. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

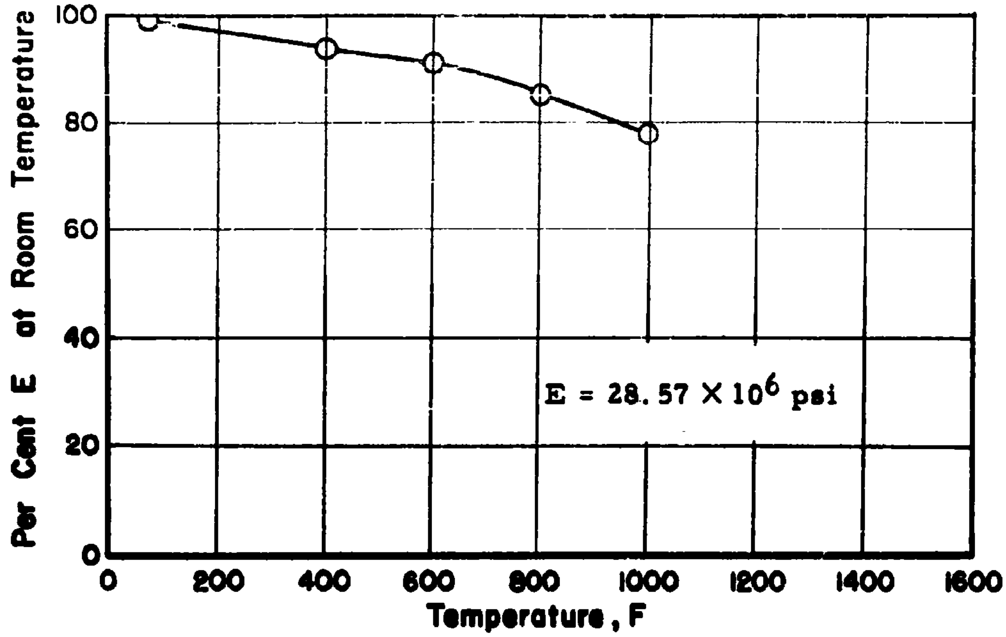


FIGURE 27. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF Ph15-7Mo EXPOSED 10 HOURS

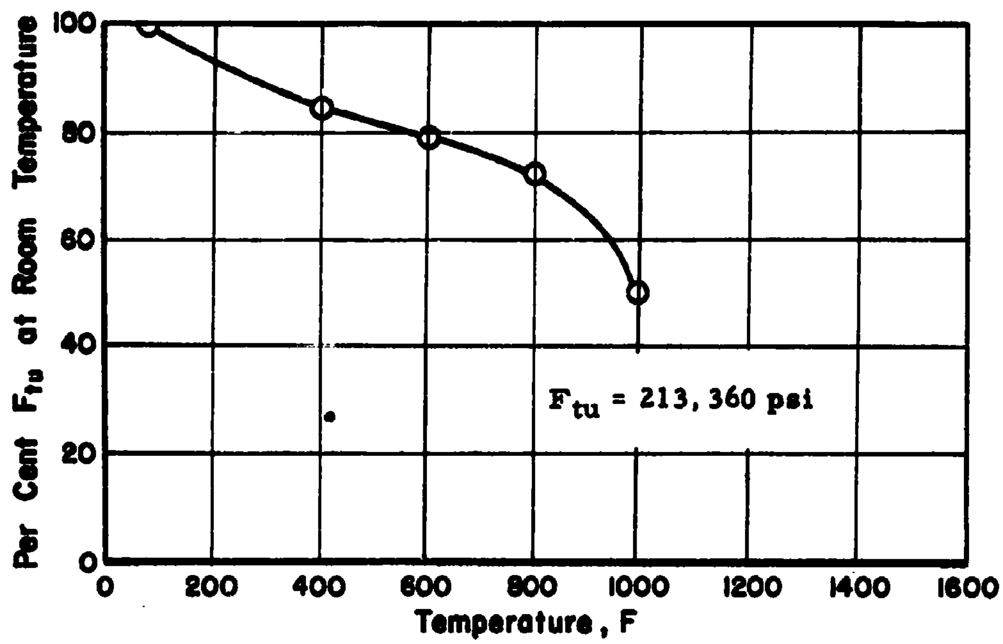


FIGURE 28. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

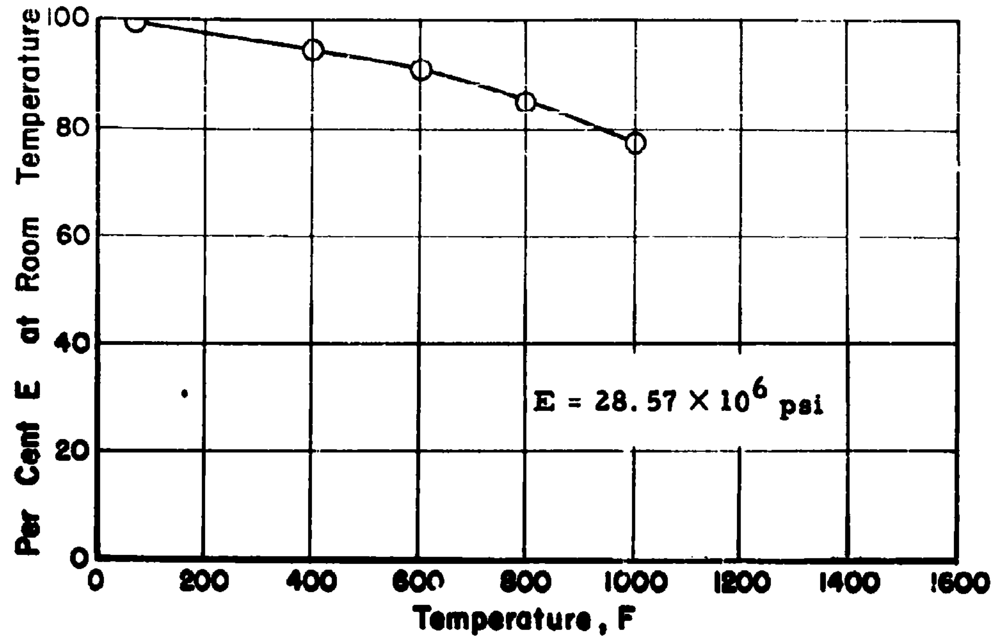


FIGURE 29. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF Ph15-7Mo EXPOSED 100 HOURS

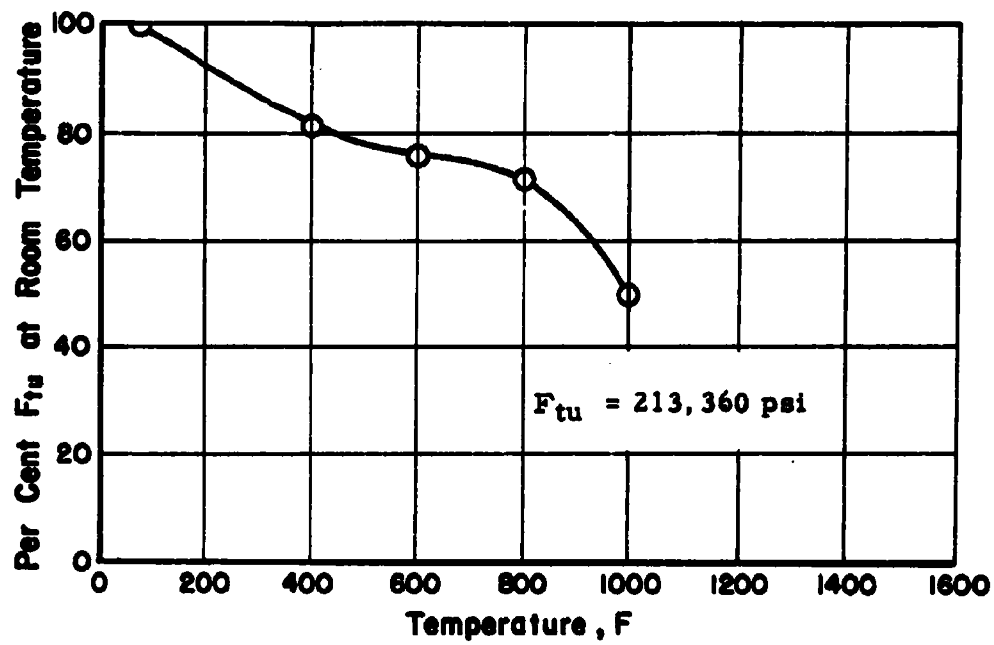


FIGURE 30. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

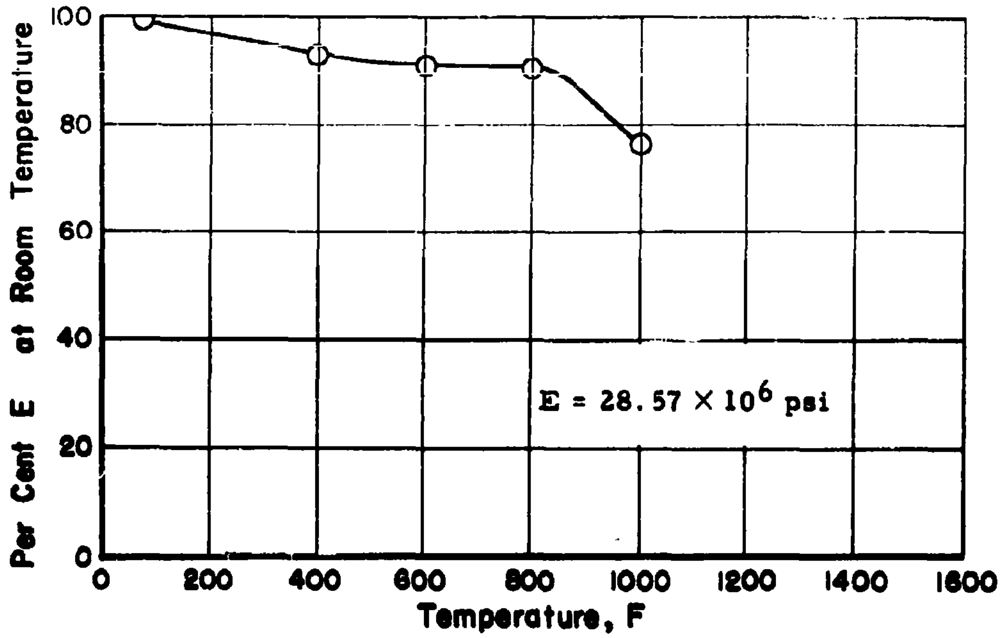


FIGURE 31. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF Ph15-7Mo EXPOSED 1000 HOURS

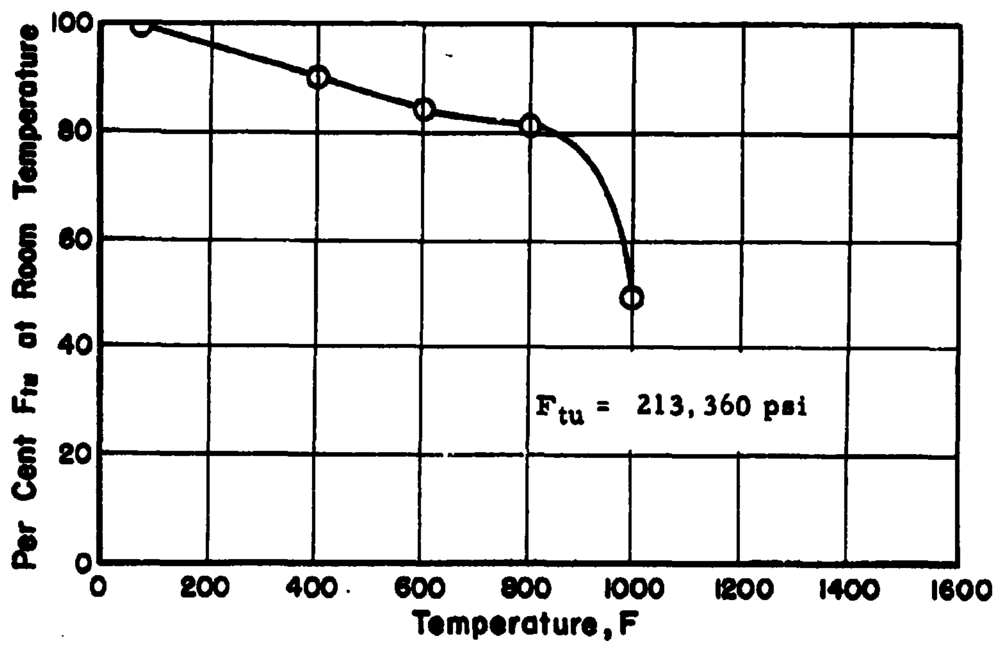


FIGURE 32. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

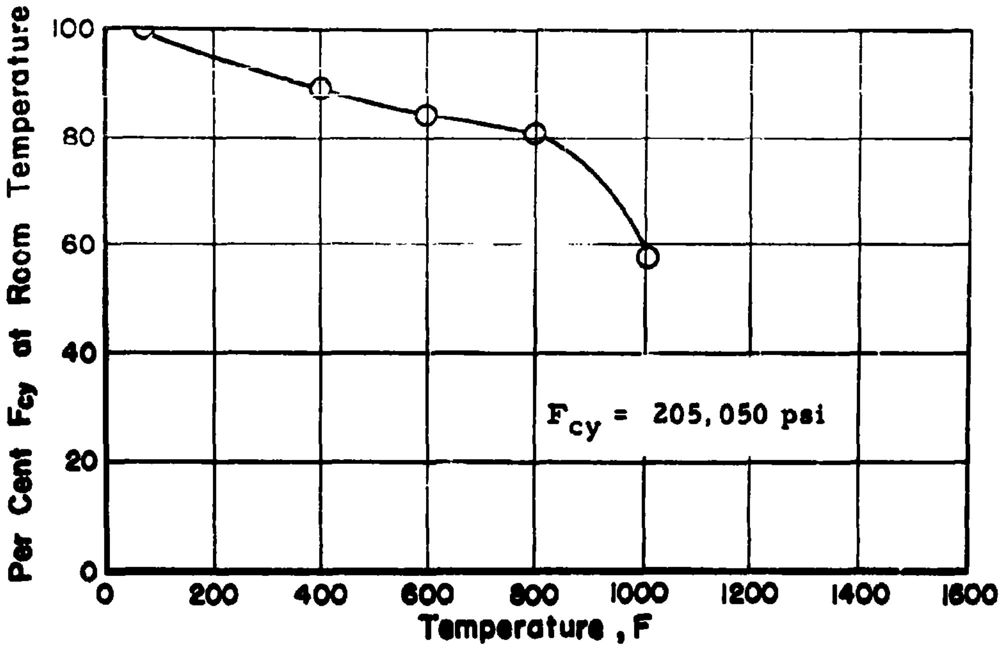


FIGURE 33. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

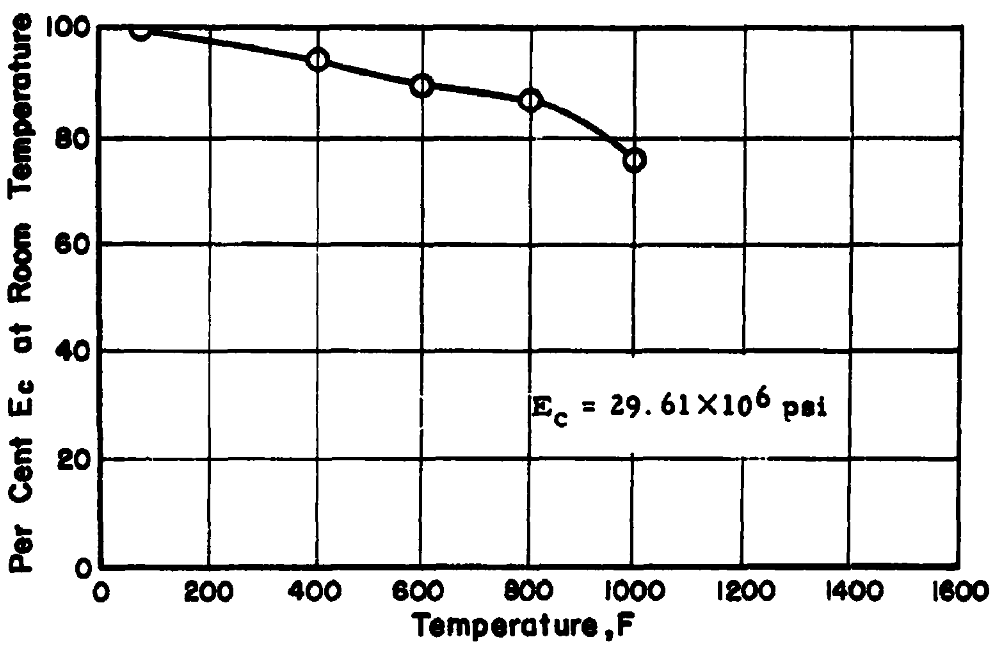


FIGURE 34. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF Ph15-7Mo EXPOSED 0.5 HOURS

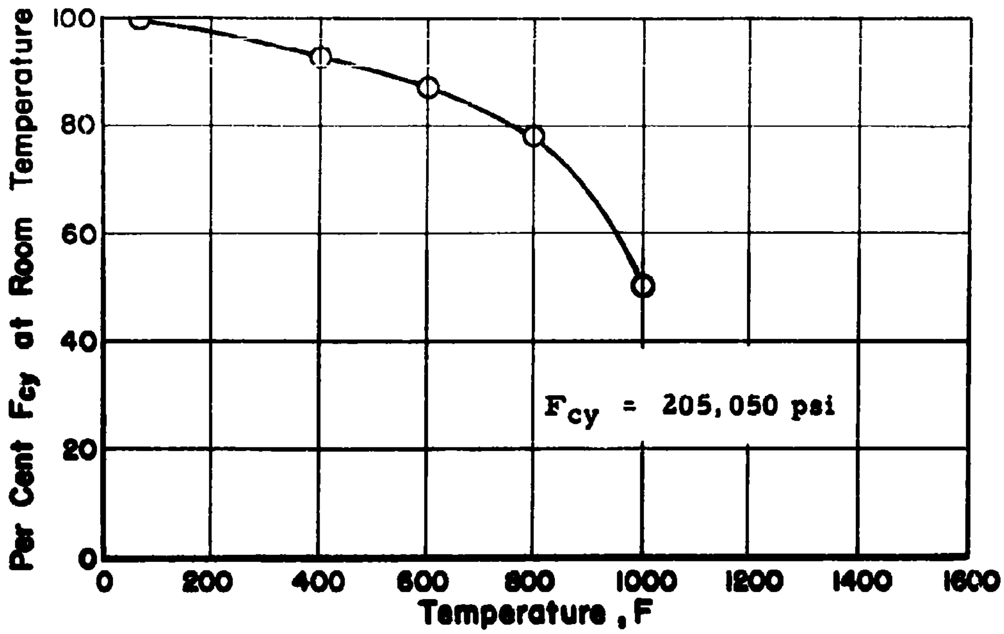


FIGURE 35. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

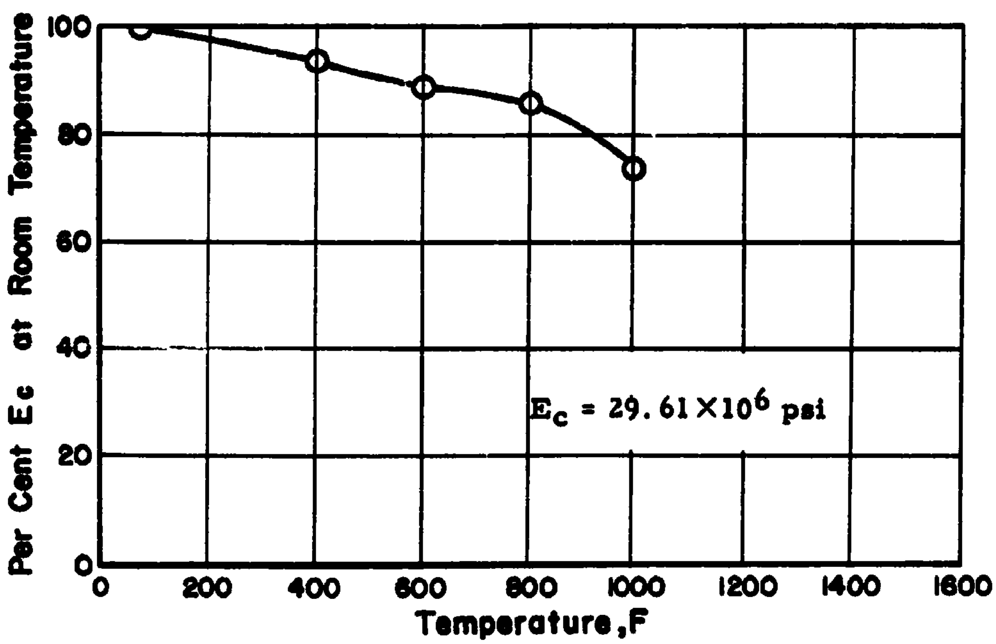


FIGURE 36. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF Ph15-7Mo EXPOSED 10 HOURS

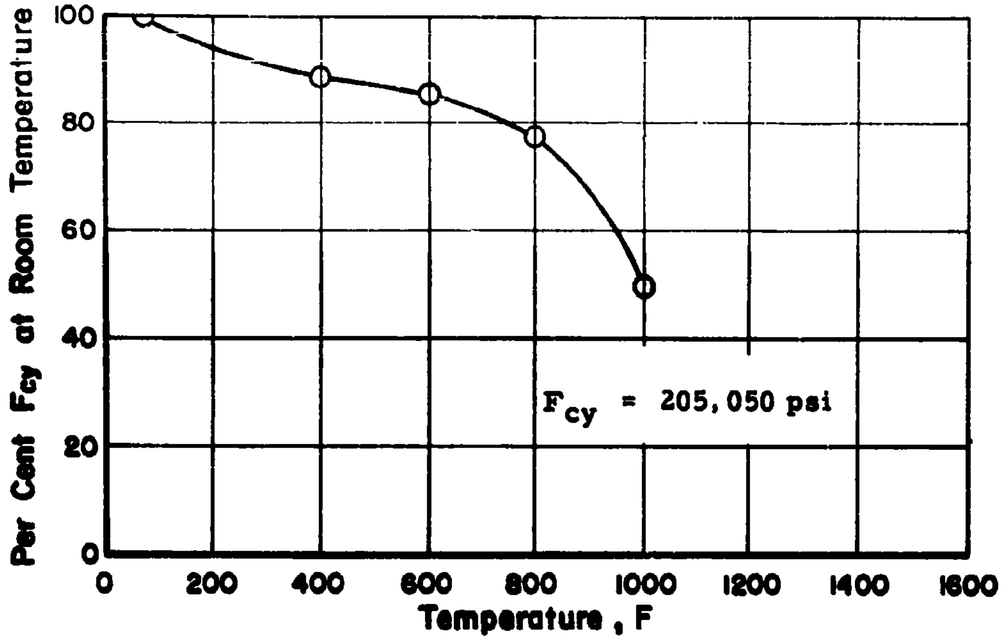


FIGURE 37. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

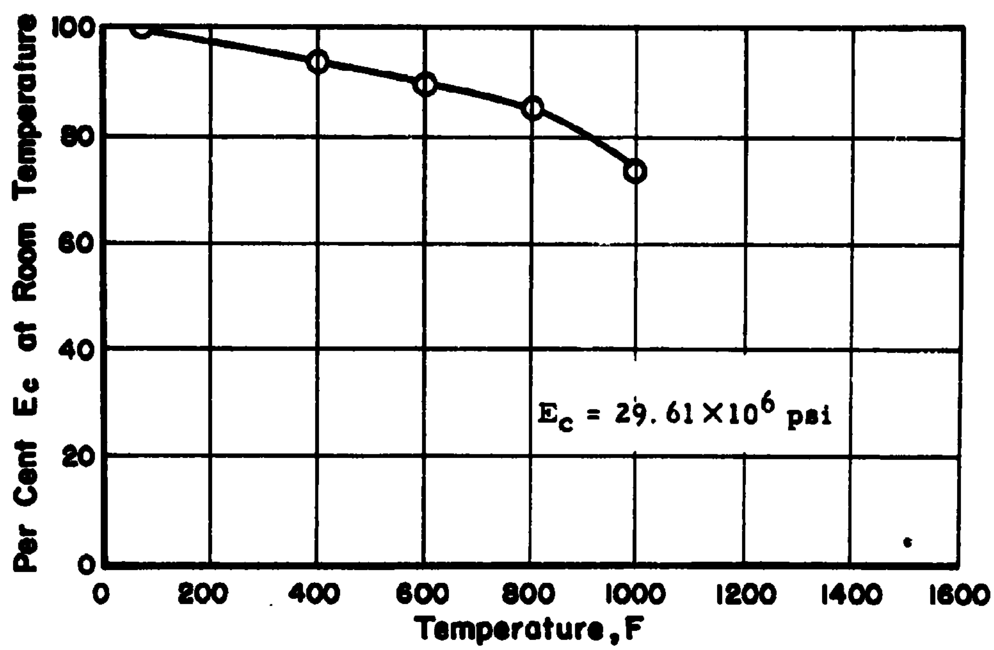


FIGURE 38. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF Ph15-7Mo EXPOSED 100 HOURS

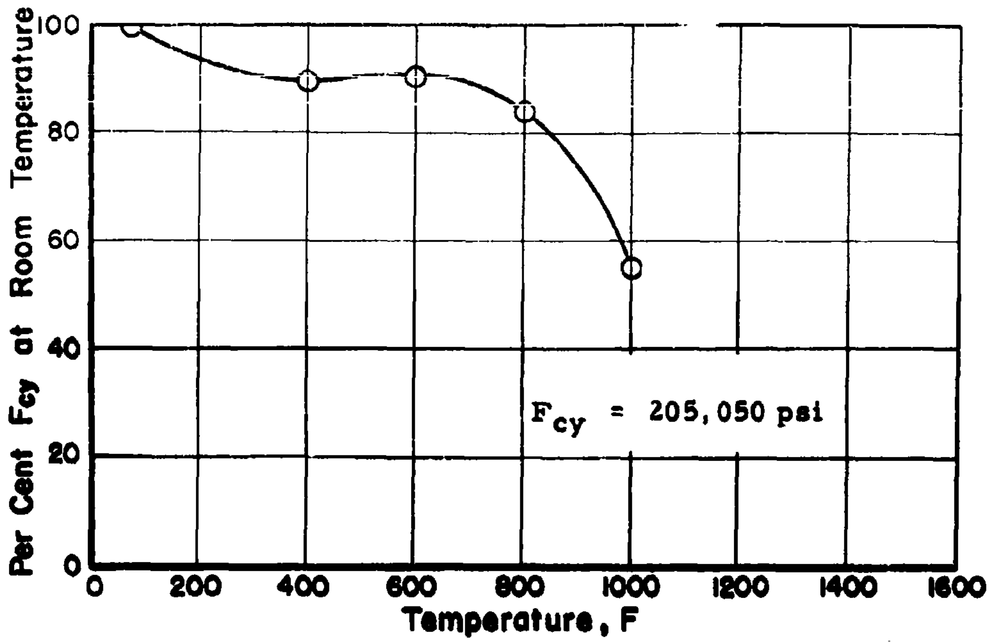


FIGURE 39. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

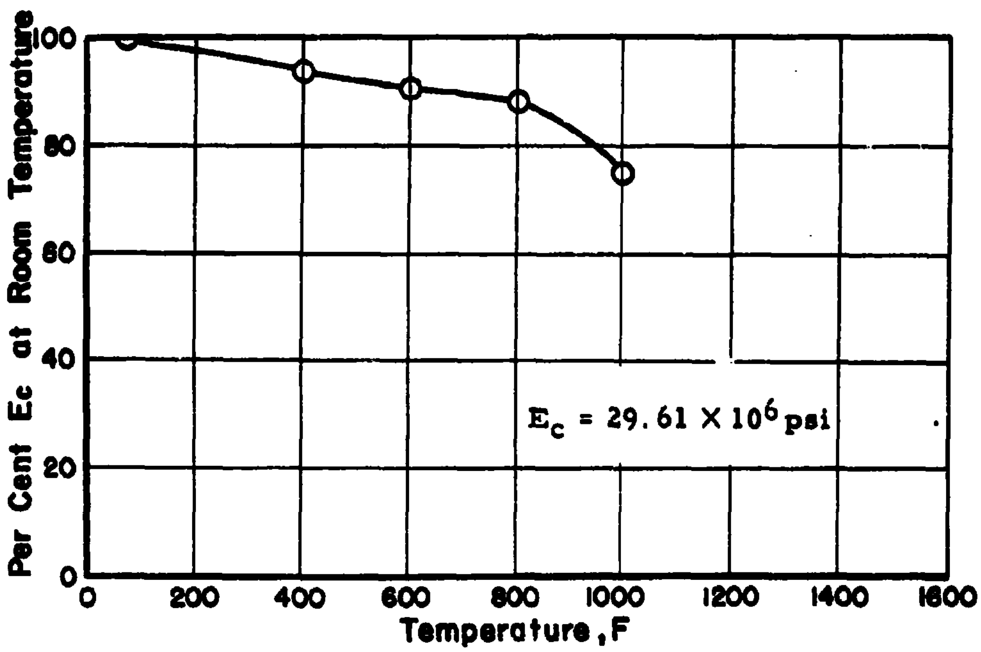


FIGURE 40. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF Ph15-7Mo EXPOSED 1000 HOURS

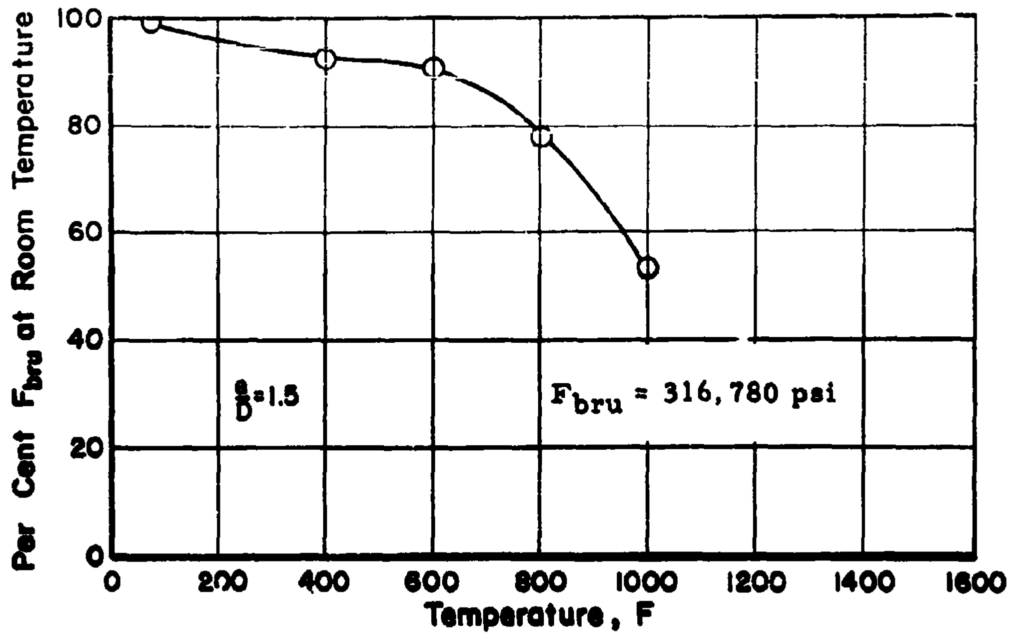


FIGURE 41. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

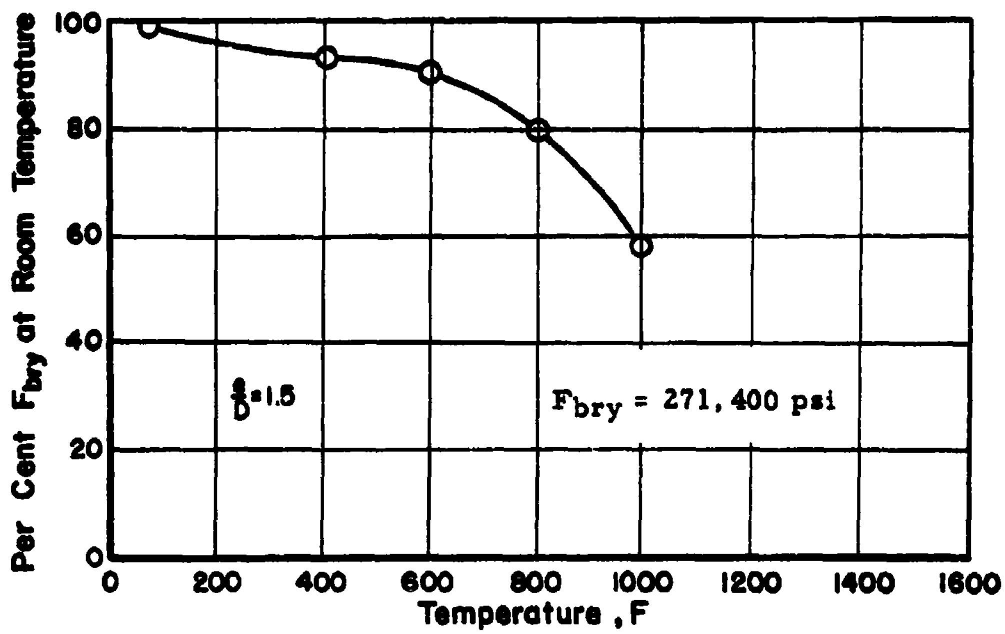


FIGURE 42. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

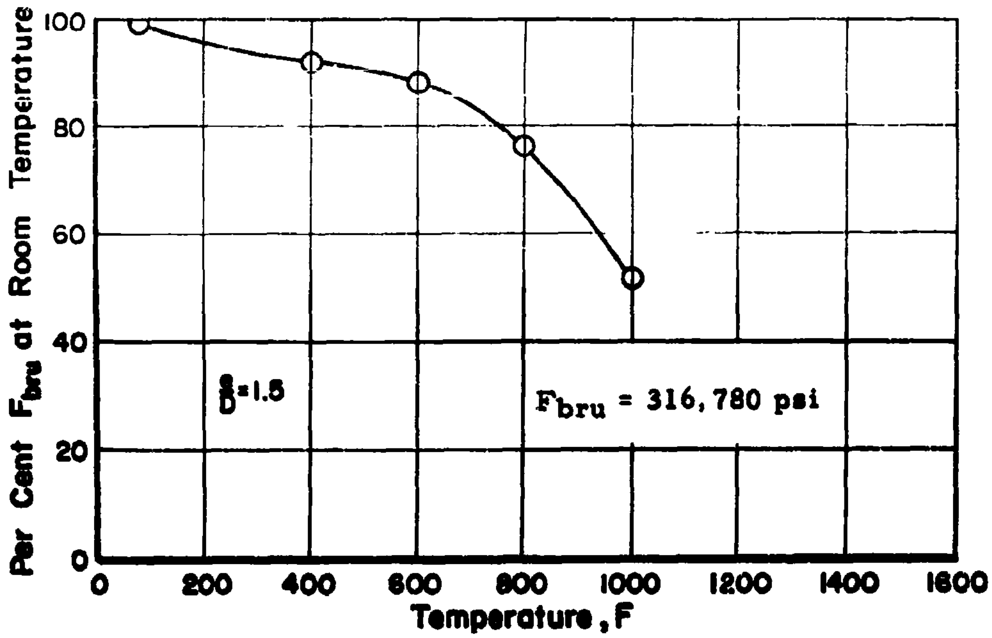


FIGURE 43. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

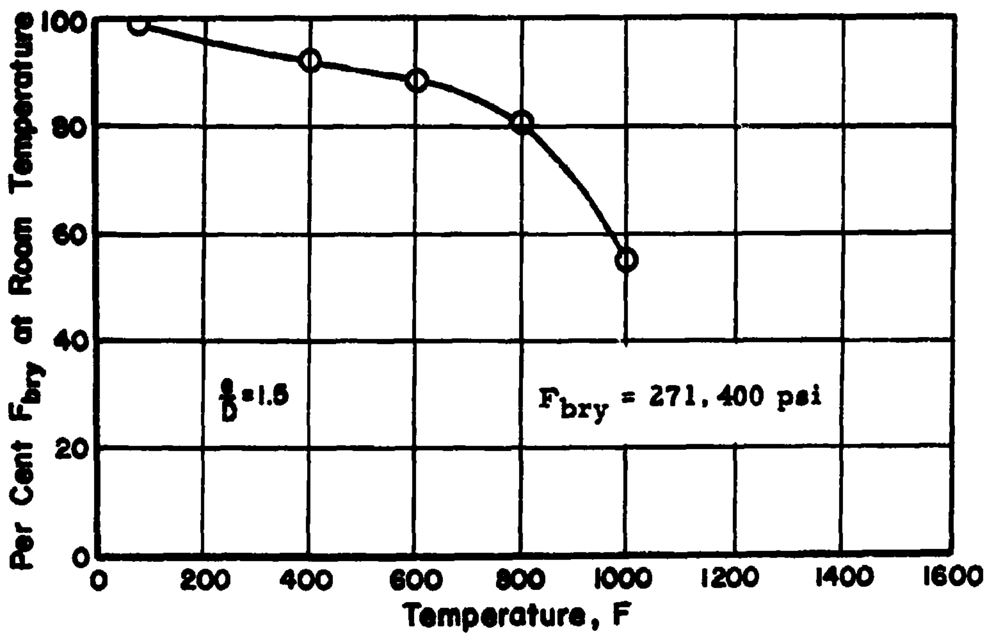


FIGURE 44. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

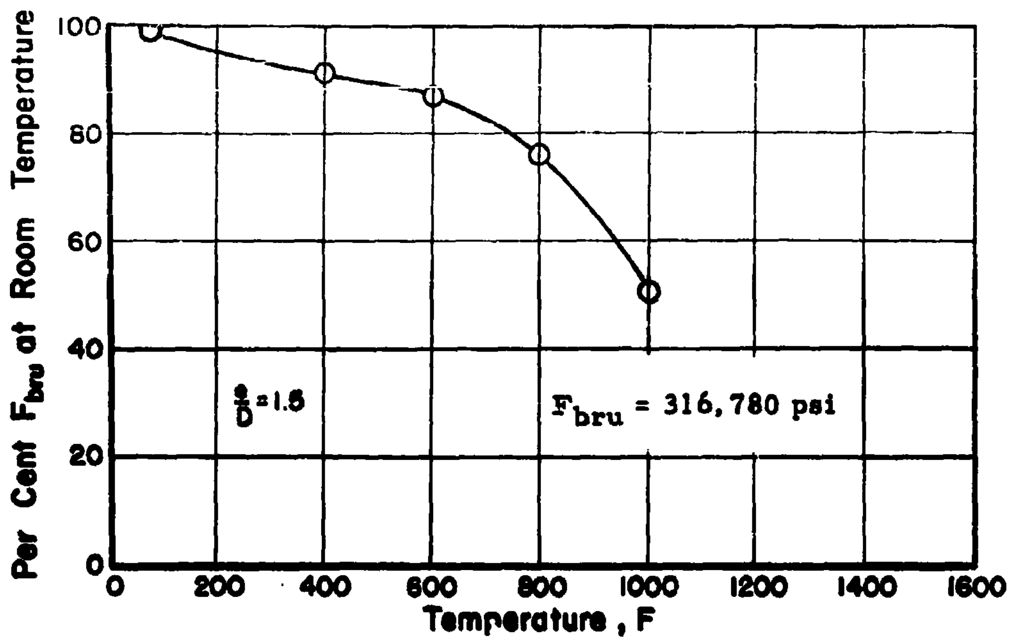


FIGURE 45. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

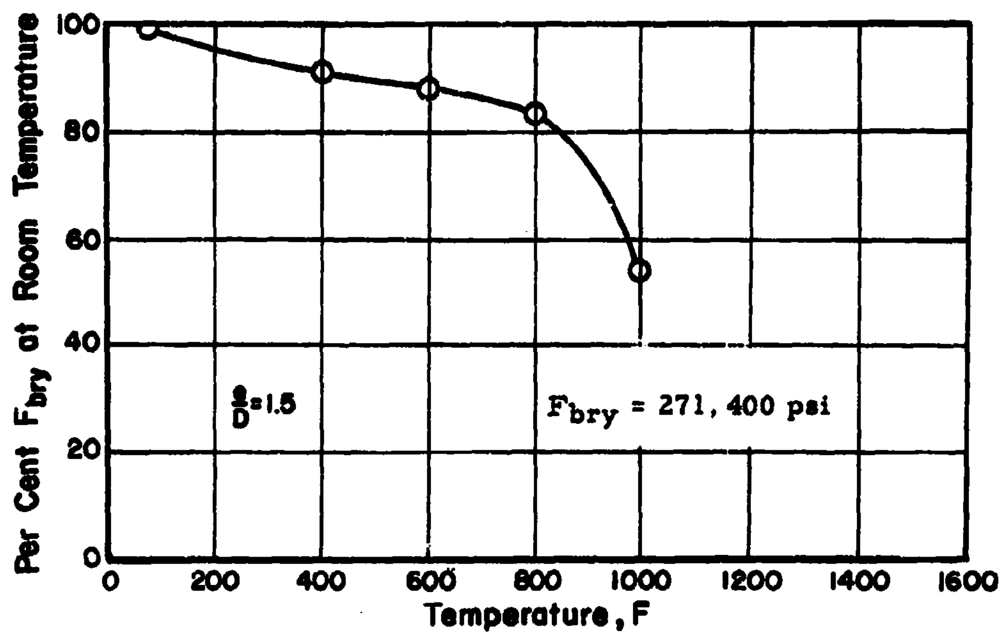


FIGURE 46. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

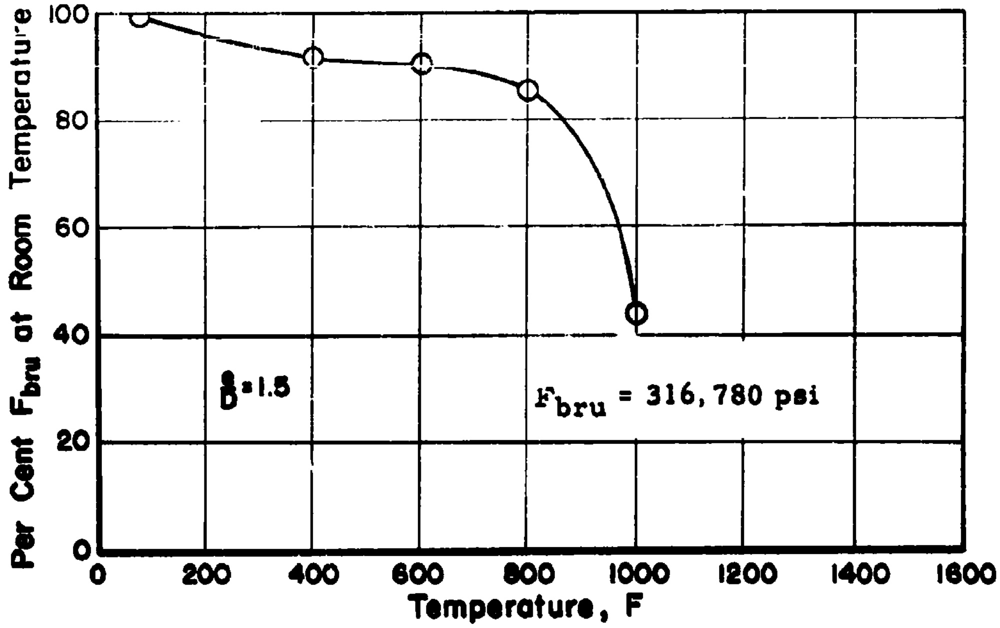


FIGURE 47. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

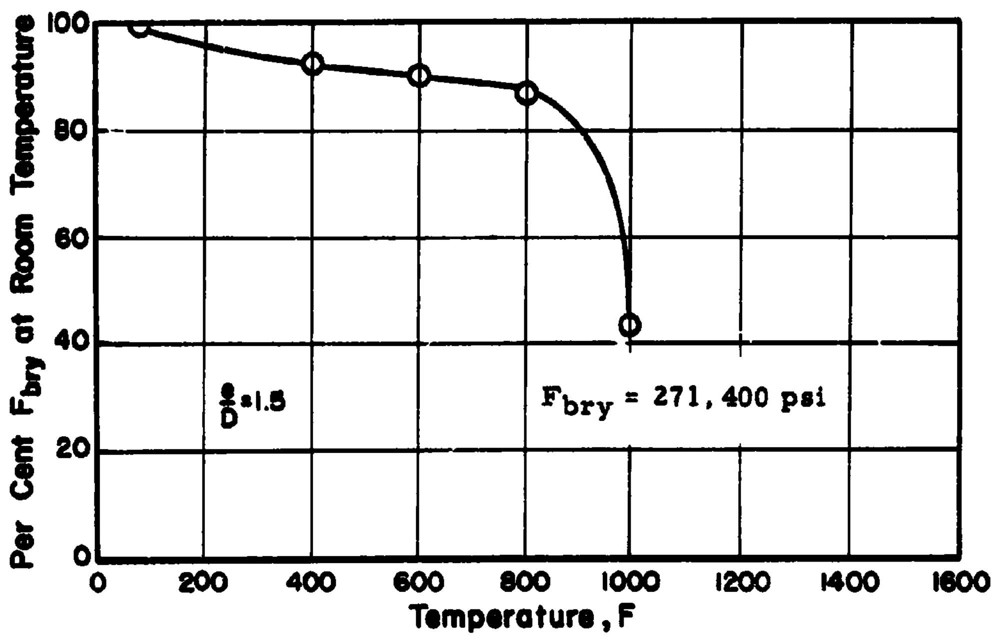


FIGURE 48. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

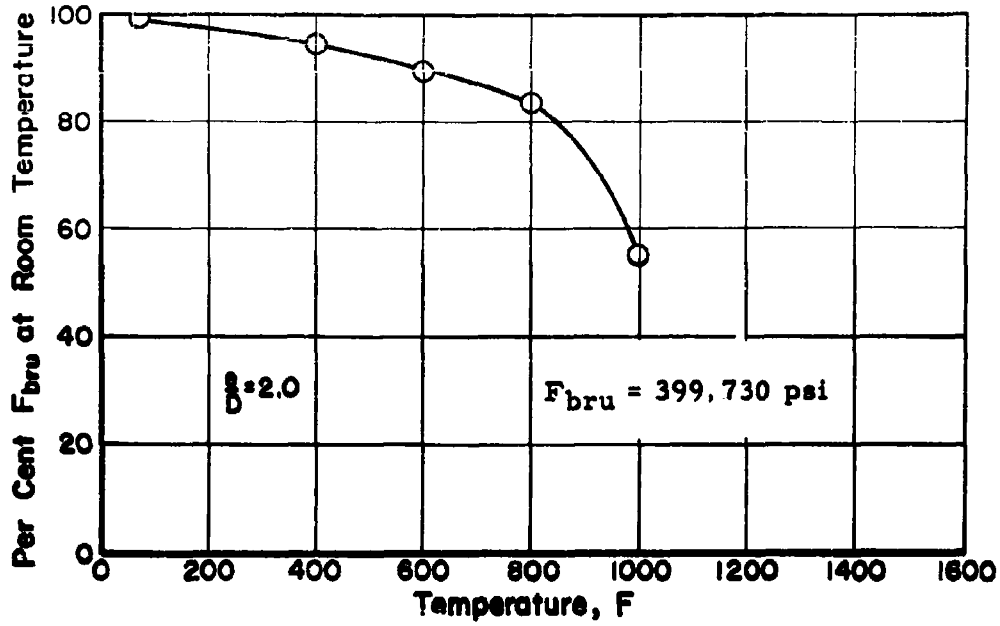


FIGURE 49. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

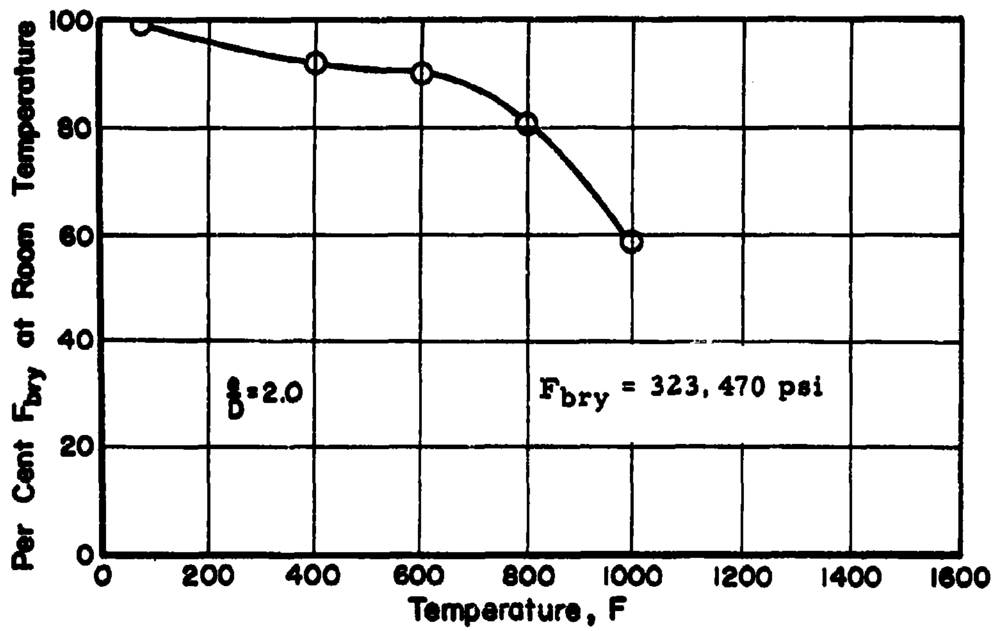


FIGURE 50. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

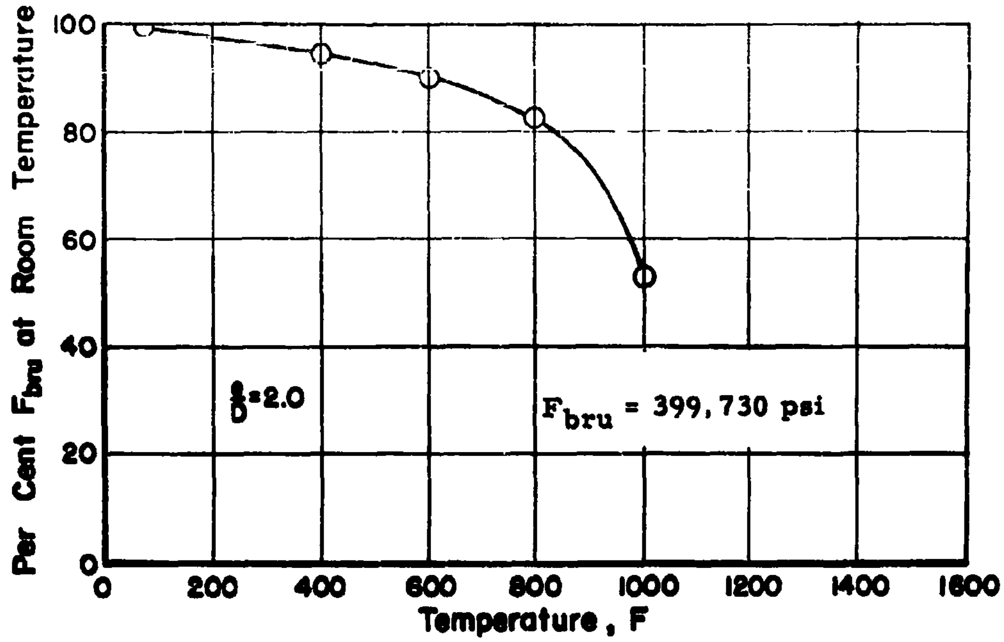


FIGURE 51. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

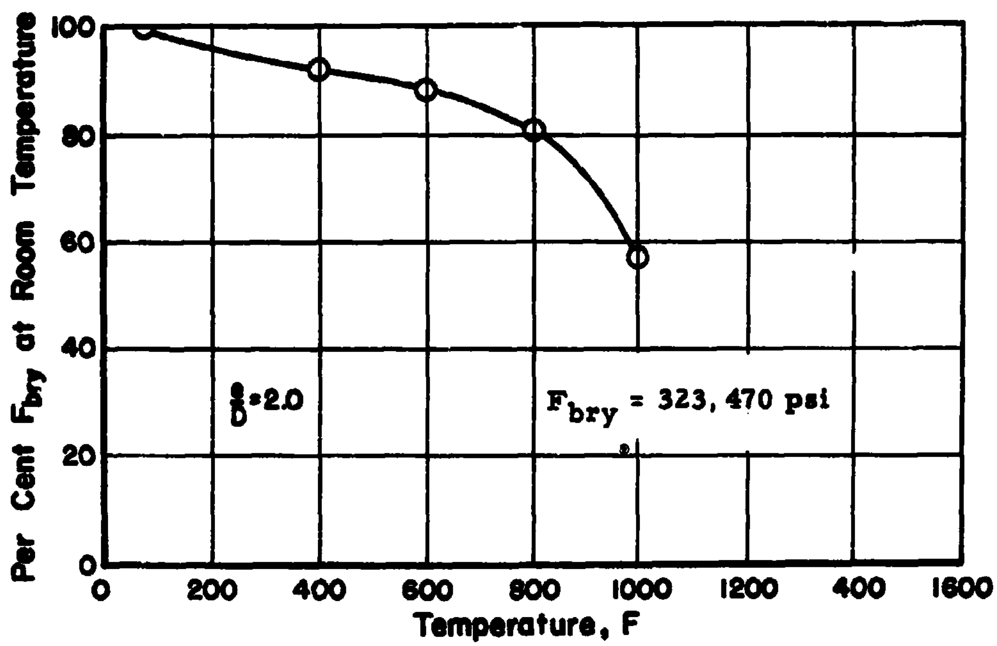


FIGURE 52. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

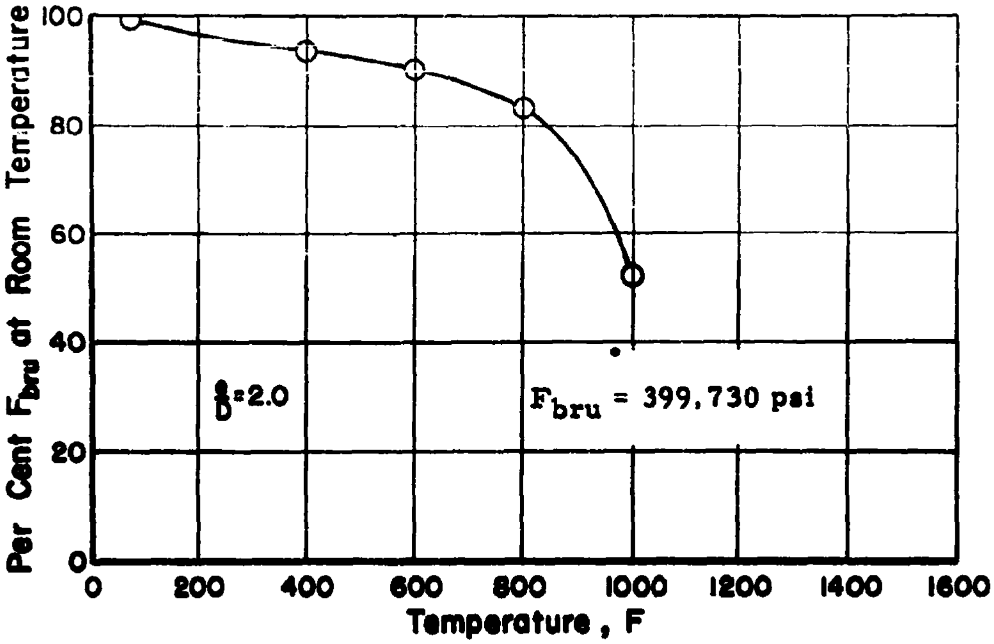


FIGURE 53. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

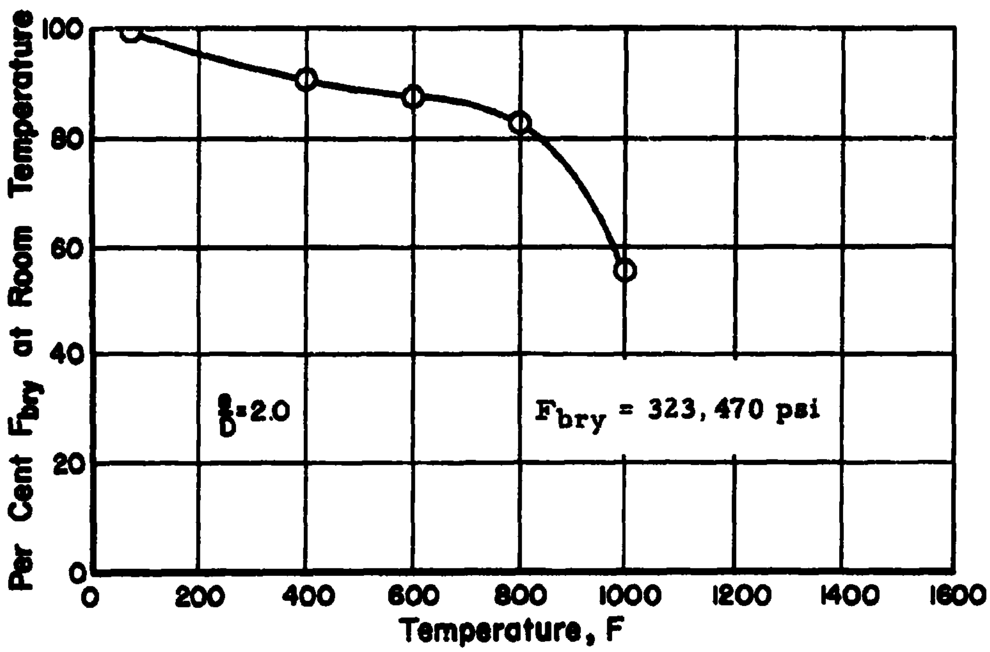


FIGURE 54. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

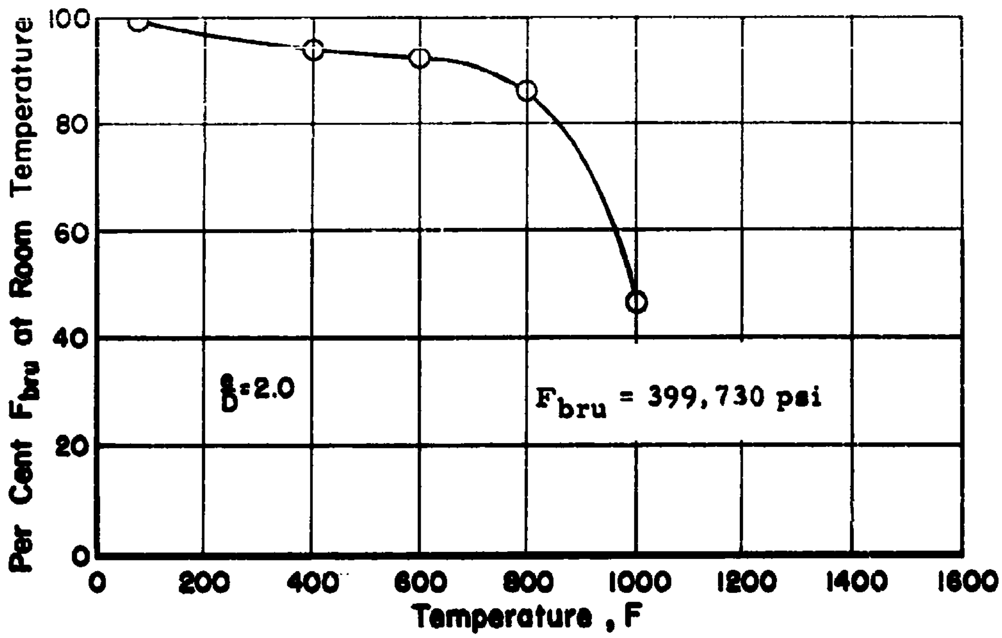


FIGURE 55. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

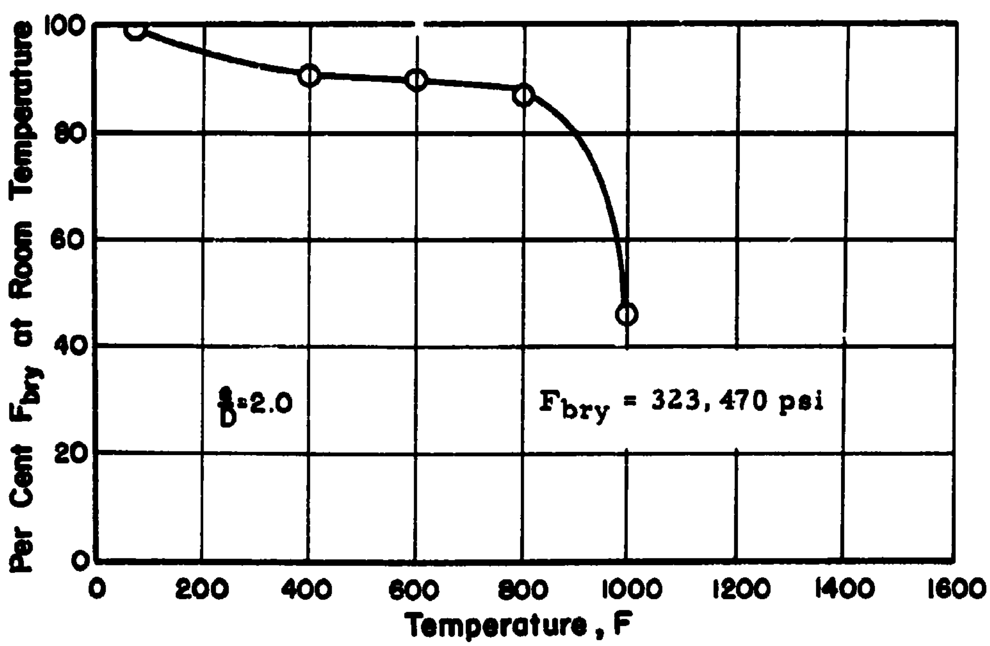


FIGURE 56. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

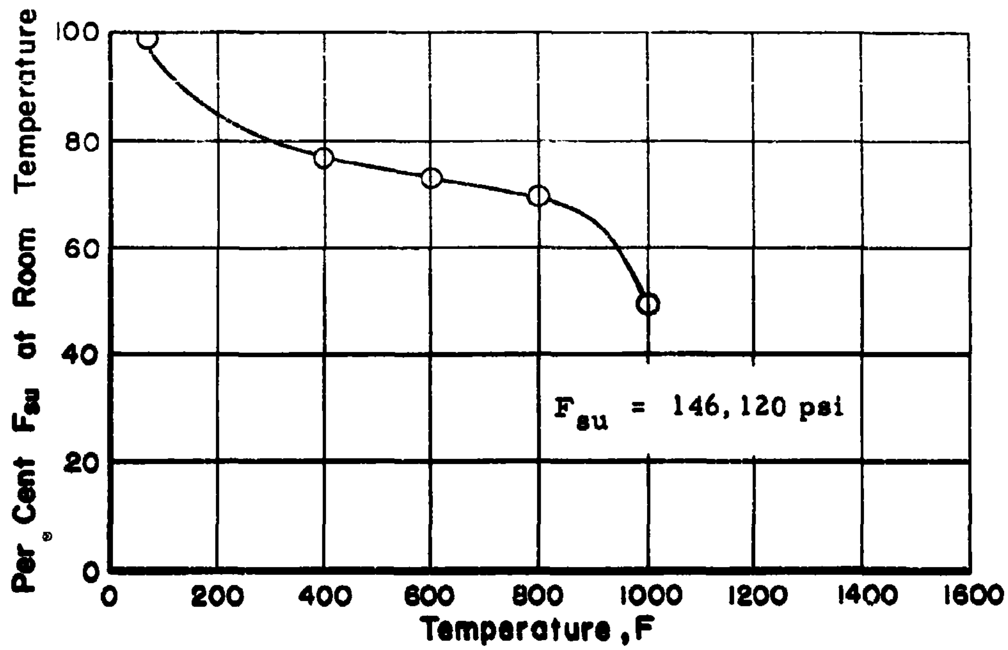


FIGURE 57. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

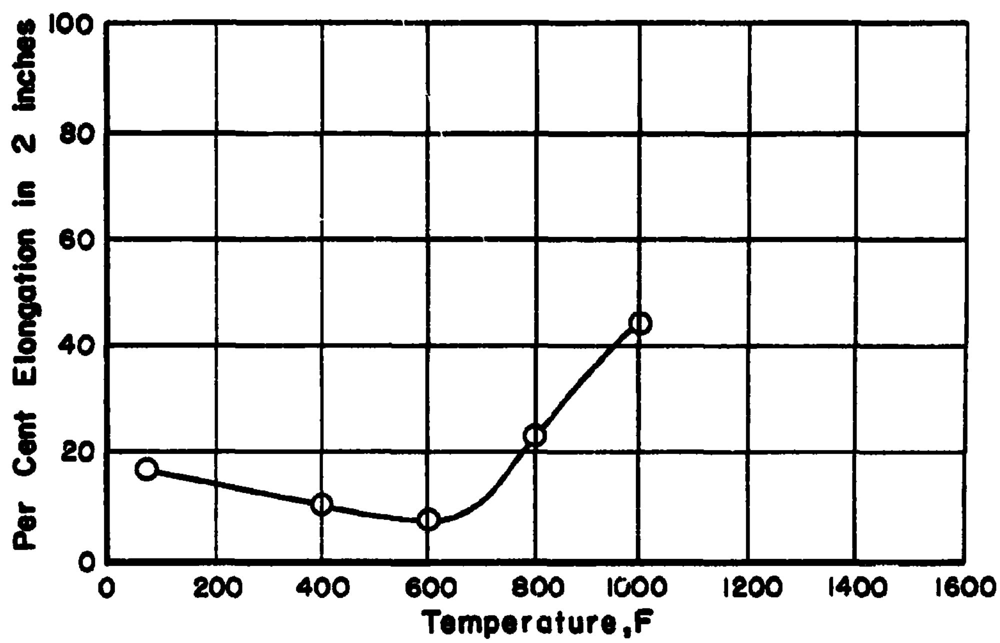


FIGURE 58. EFFECT OF TEMPERATURE ON ELONGATION OF Ph15-7Mo EXPOSED 0.5 HOURS

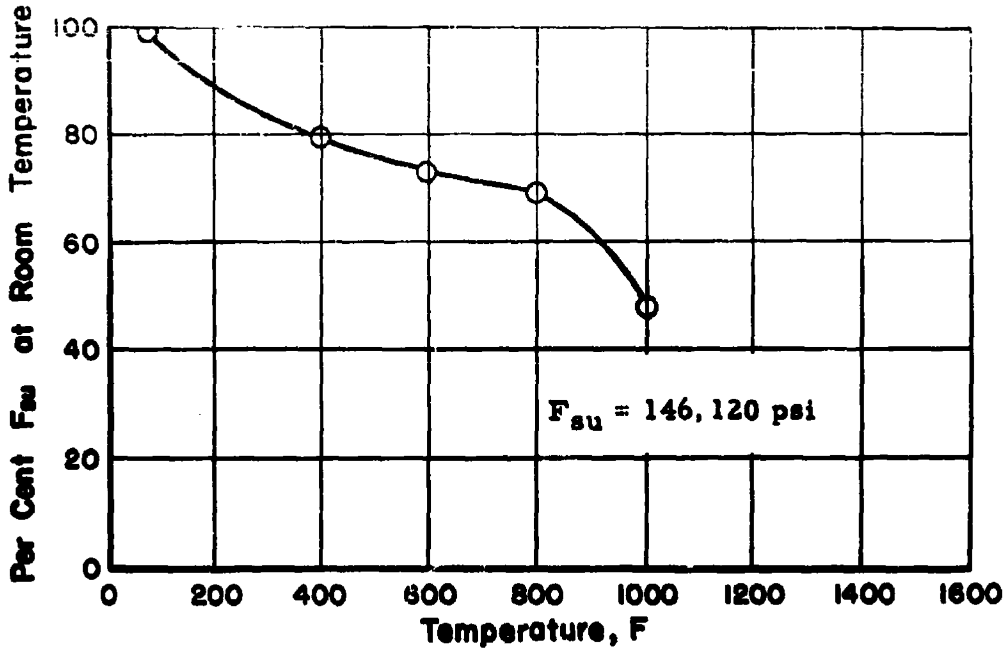


FIGURE 59. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

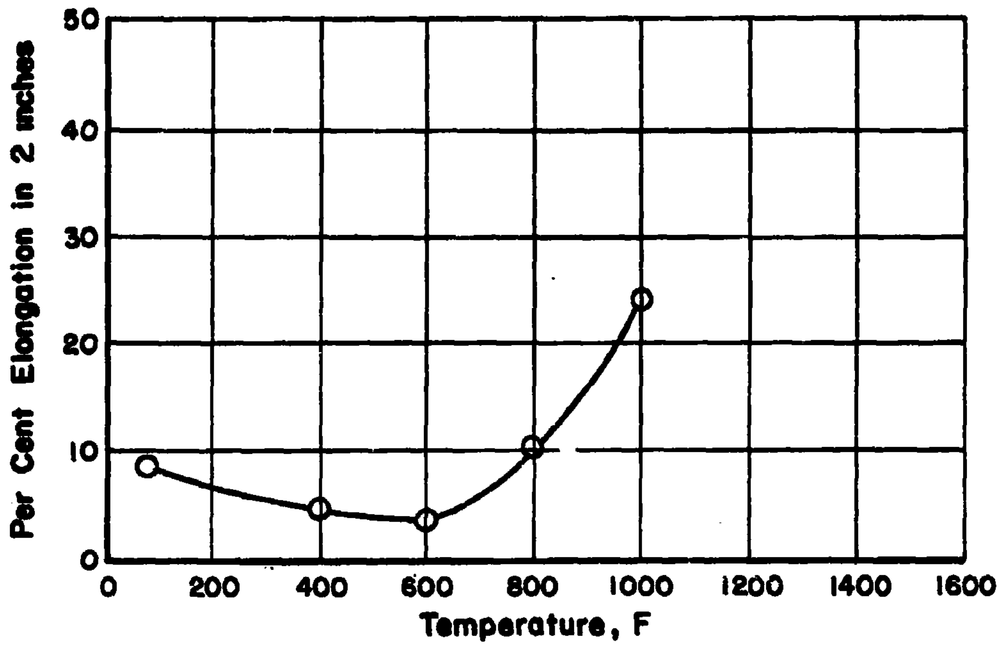


FIGURE 60. EFFECT OF TEMPERATURE ON ELONGATION OF Ph15-7Mo EXPOSED 10 HOURS

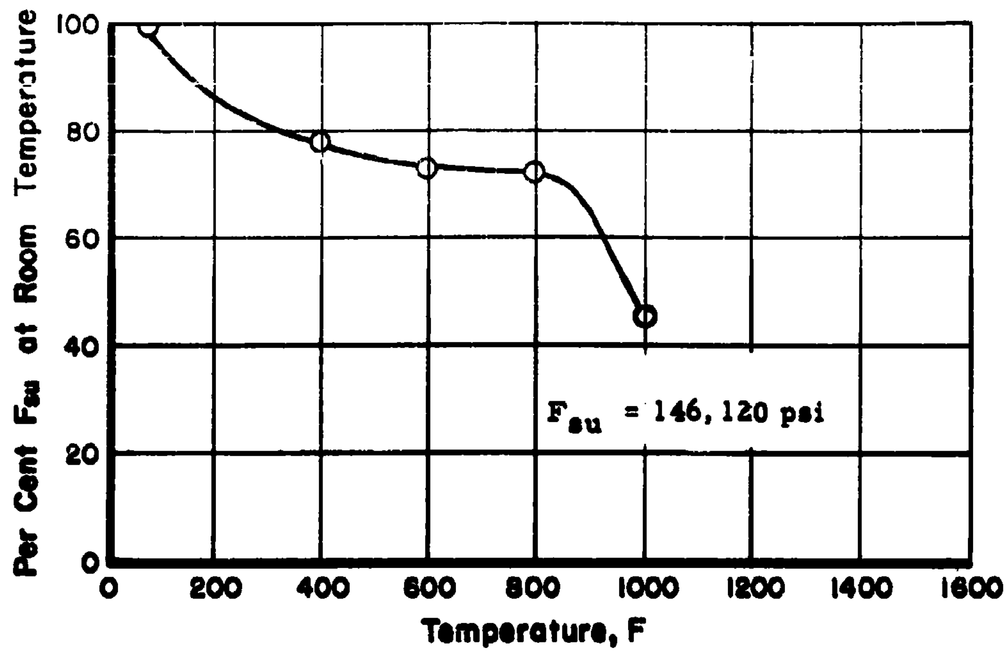


FIGURE 61. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

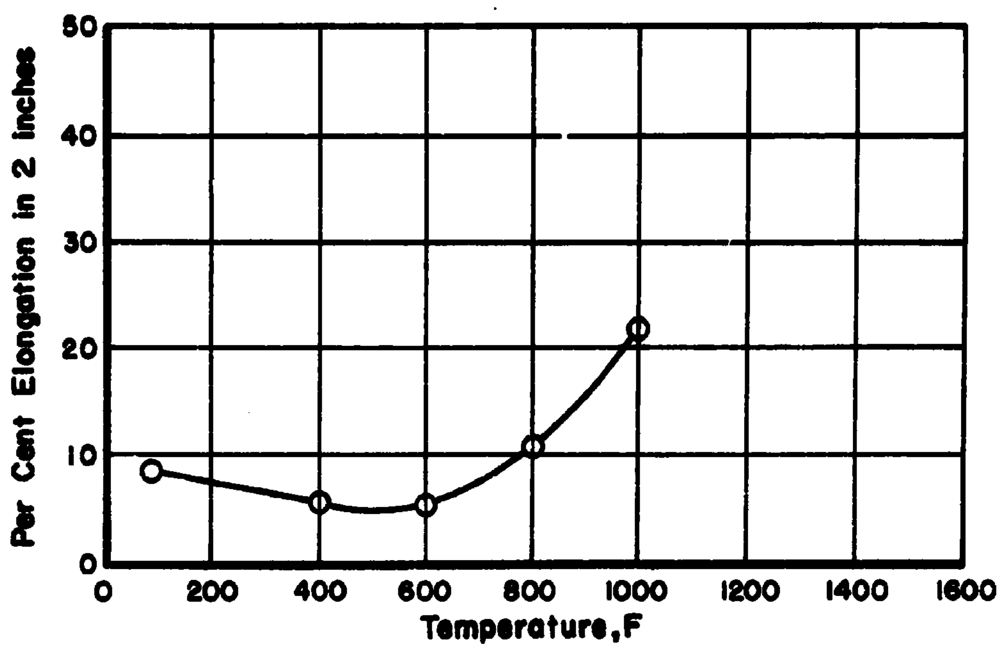


FIGURE 62. EFFECT OF TEMPERATURE ON ELONGATION OF Ph15-7Mo EXPOSED 100 HOURS

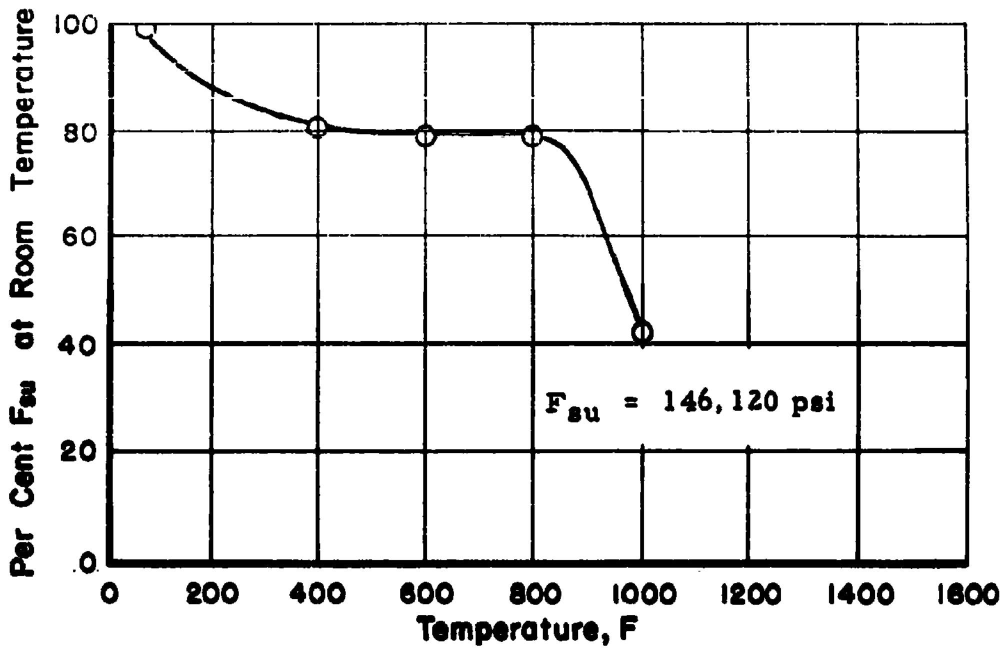


FIGURE 63. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

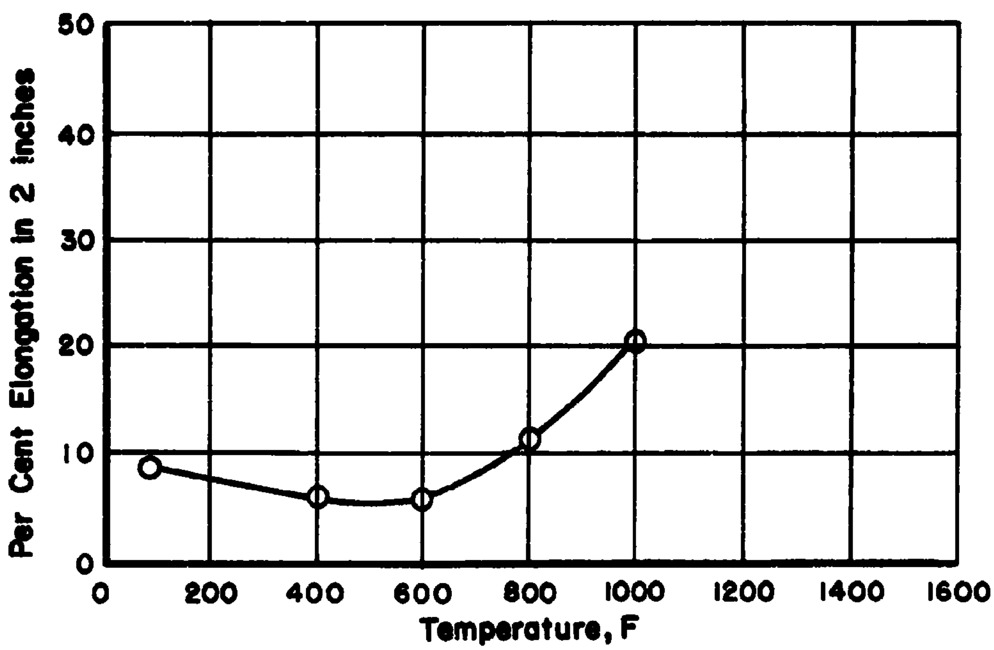


FIGURE 64. EFFECT OF TEMPERATURE ON ELONGATION OF Ph15-7Mo EXPOSED 1000 HOURS

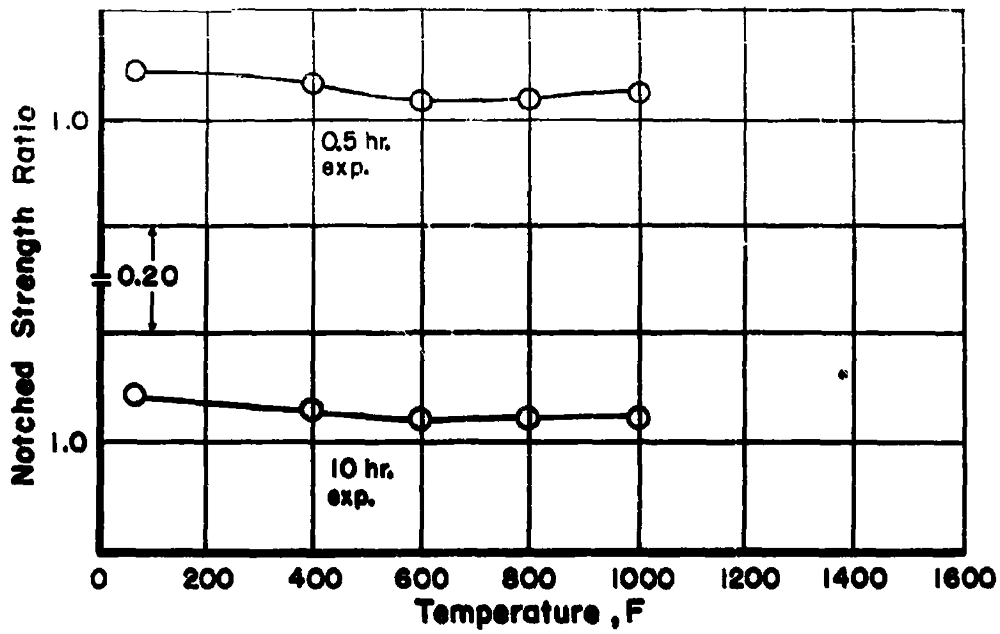


FIGURE 65. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF Ph15-7Mo EXPOSED 0.5 AND 10 HOURS

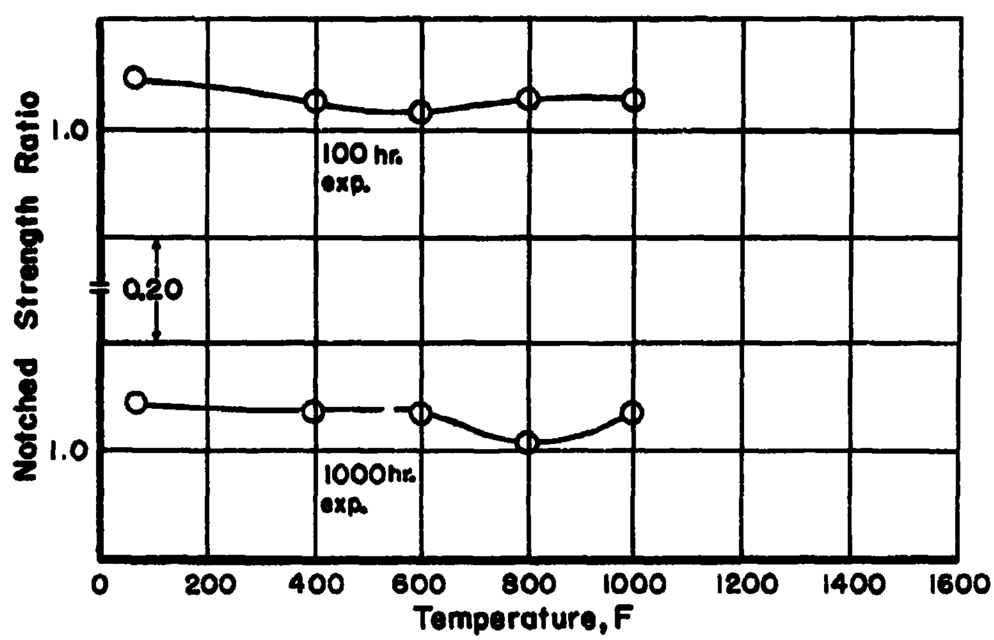


FIGURE 66. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF Ph15-7Mo EXPOSED 100 AND 1000 HOURS

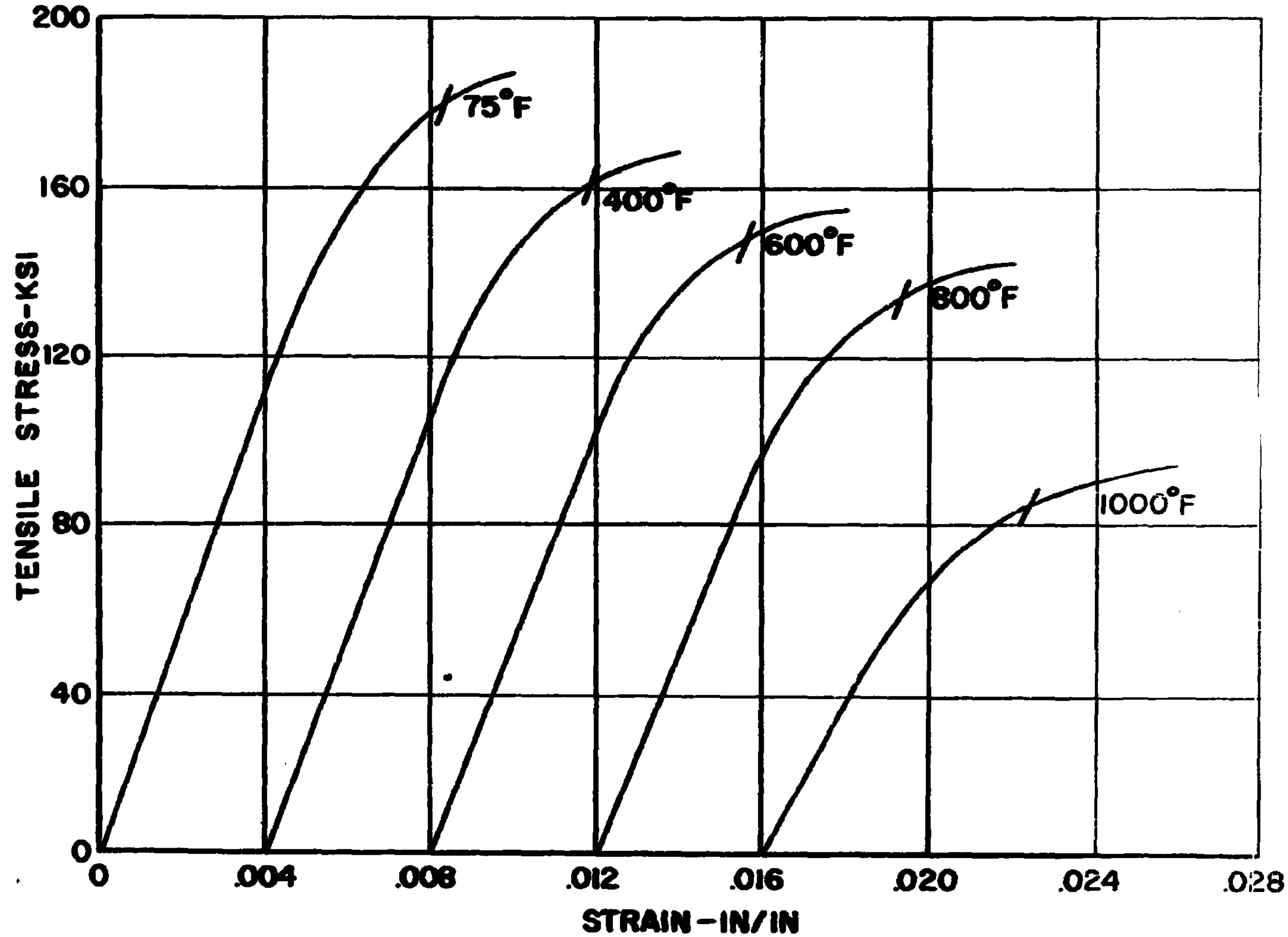


FIGURE 67. TENSILE STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 0.5 HOURS

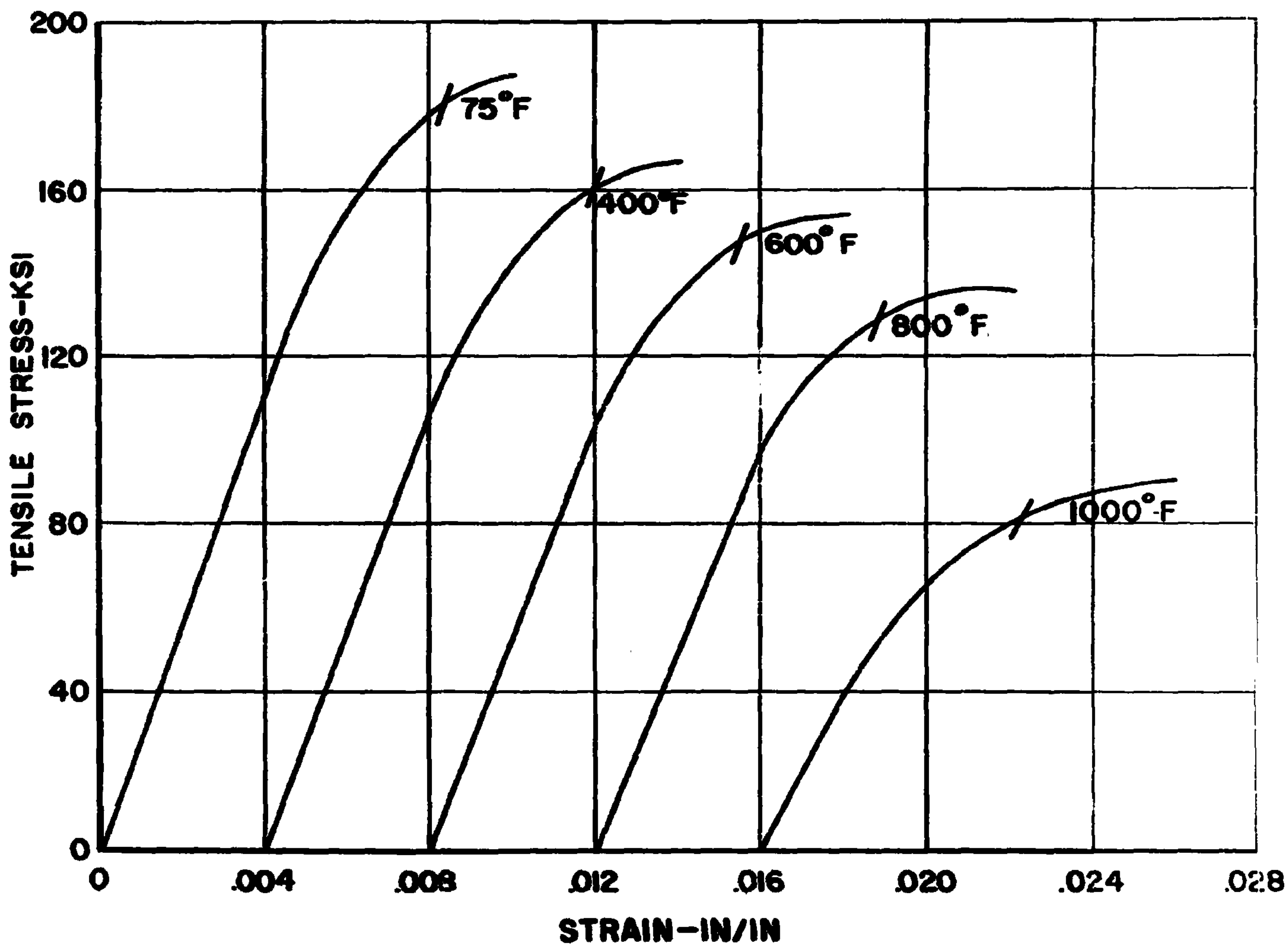


FIGURE 68. TENSILE STRESS-STRAIN CURVES OF Ph15-7Mo EXPOSED 10 HOURS

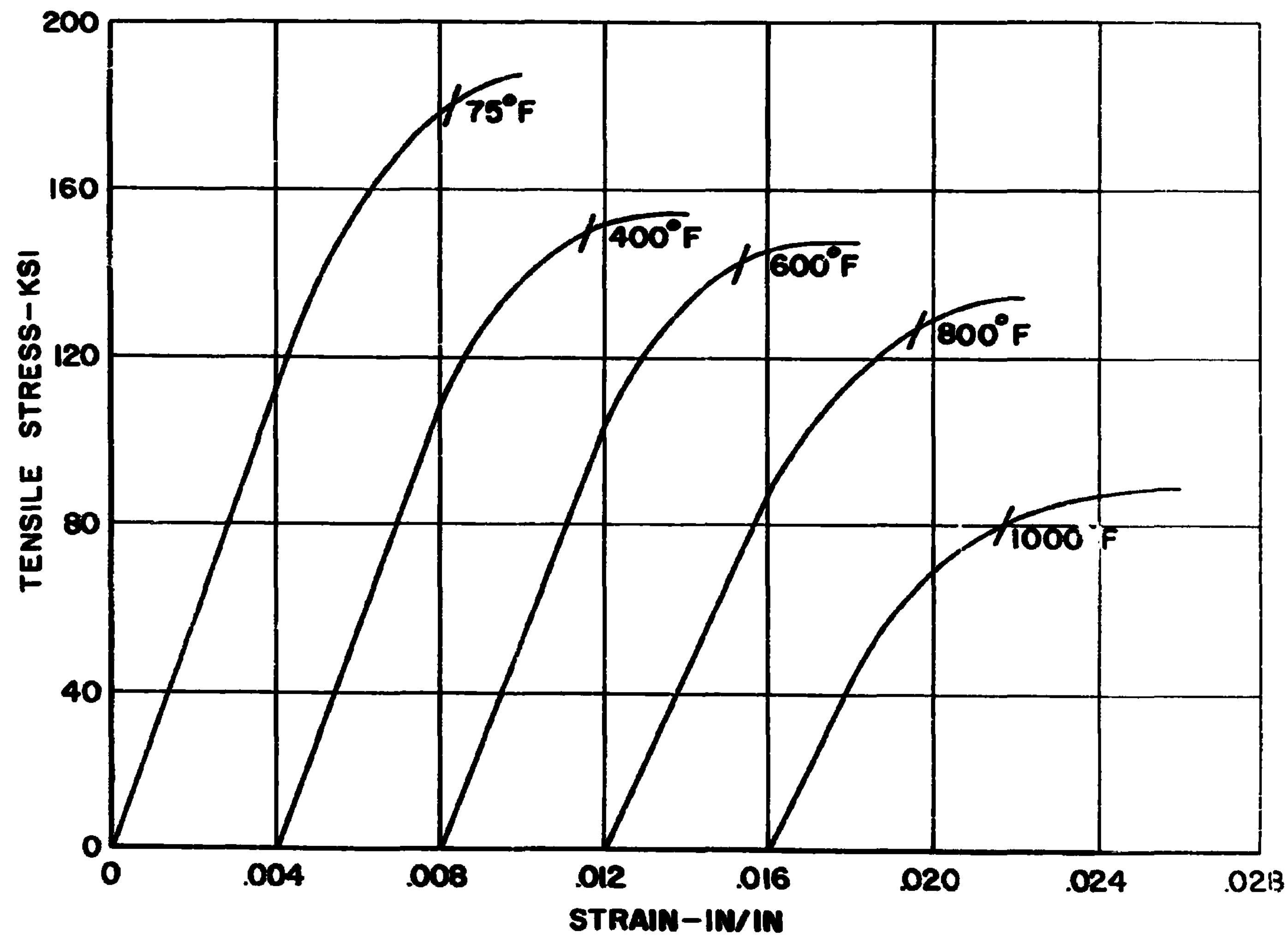


FIGURE 69. TENSILE STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 100 HOURS

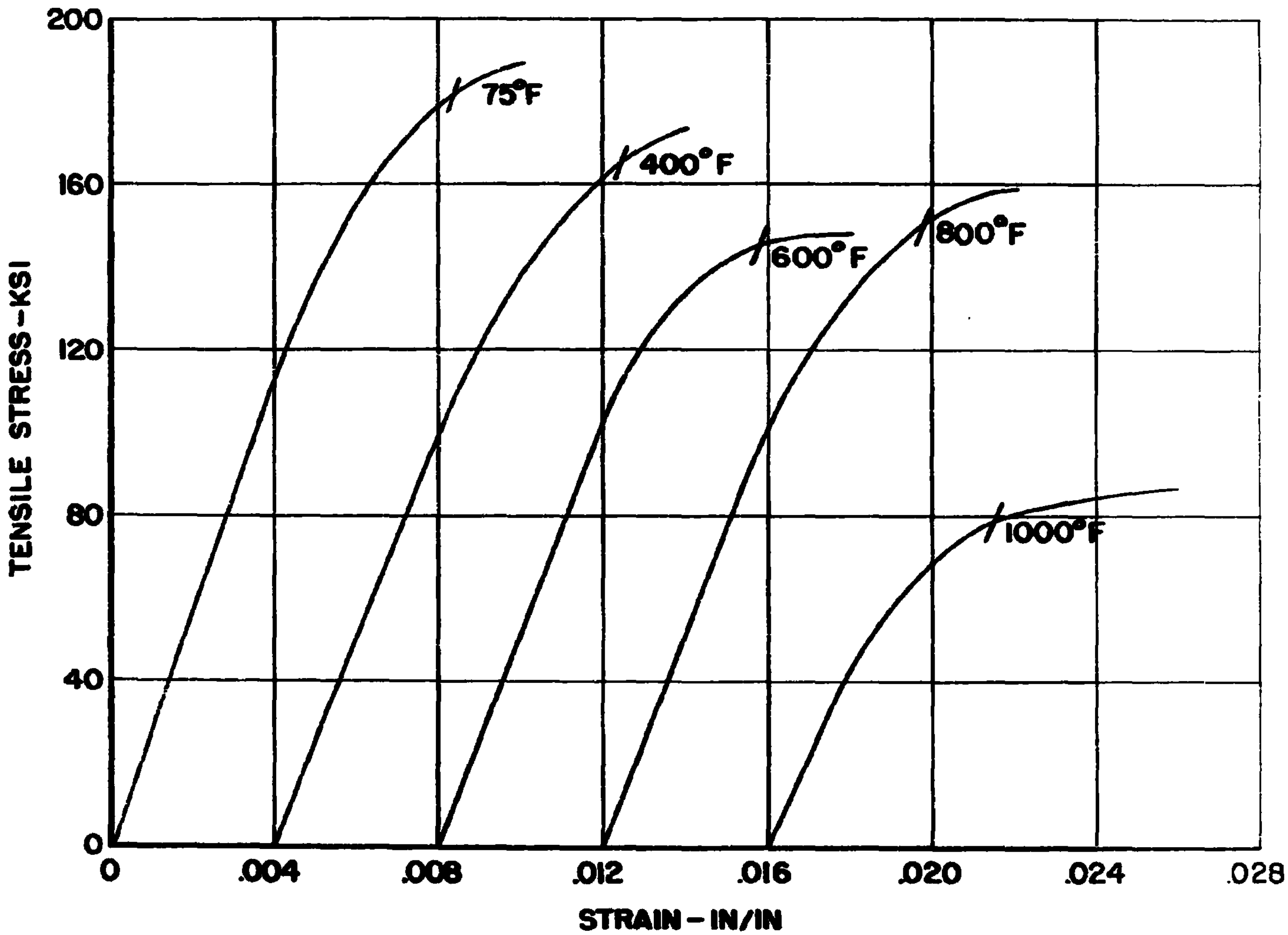


FIGURE 70. TENSILE STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 1000 HOURS

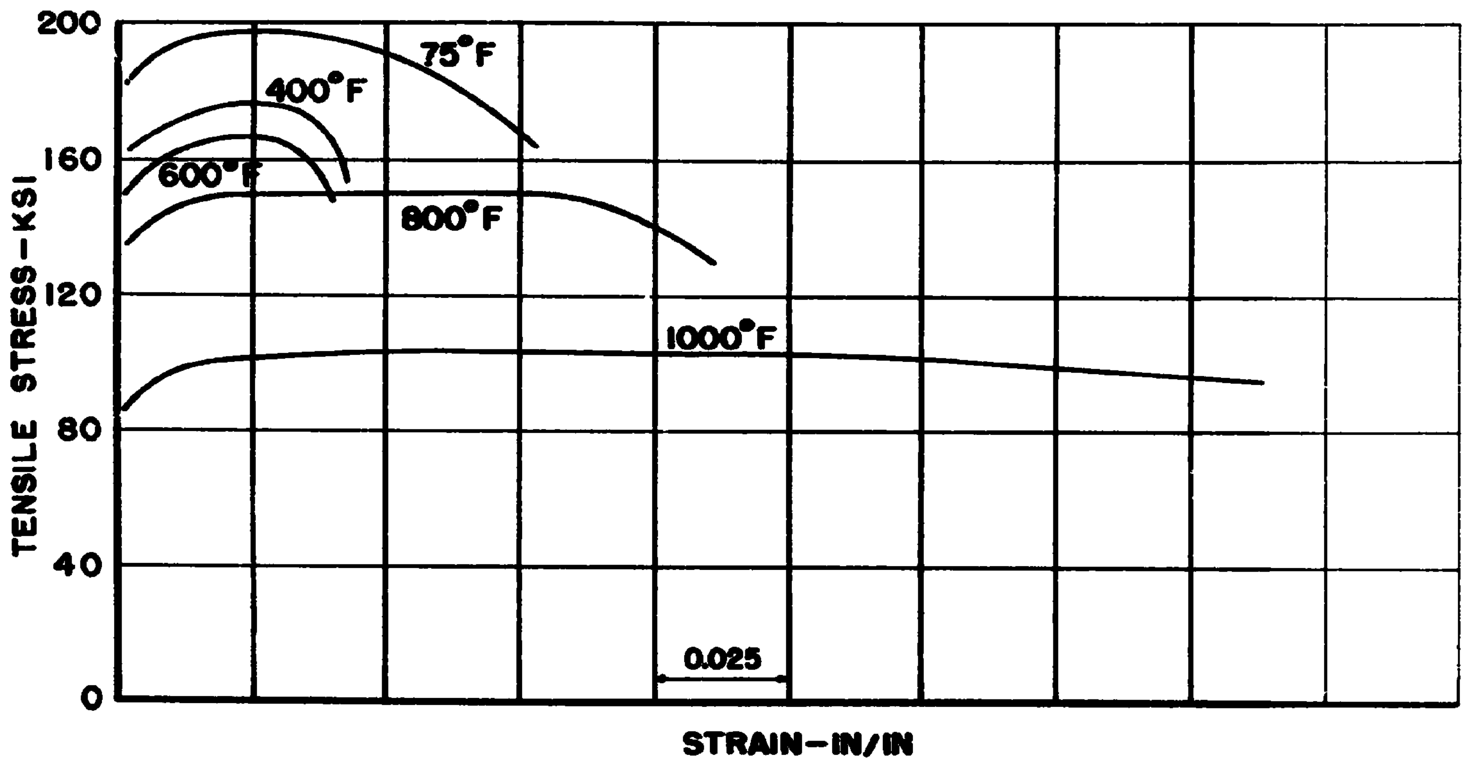


FIGURE 71. TENSILE POSTYIELD STRESS-STRAIN CURVES OF Ph15-7Mo EXPOSED 0.5 HOURS

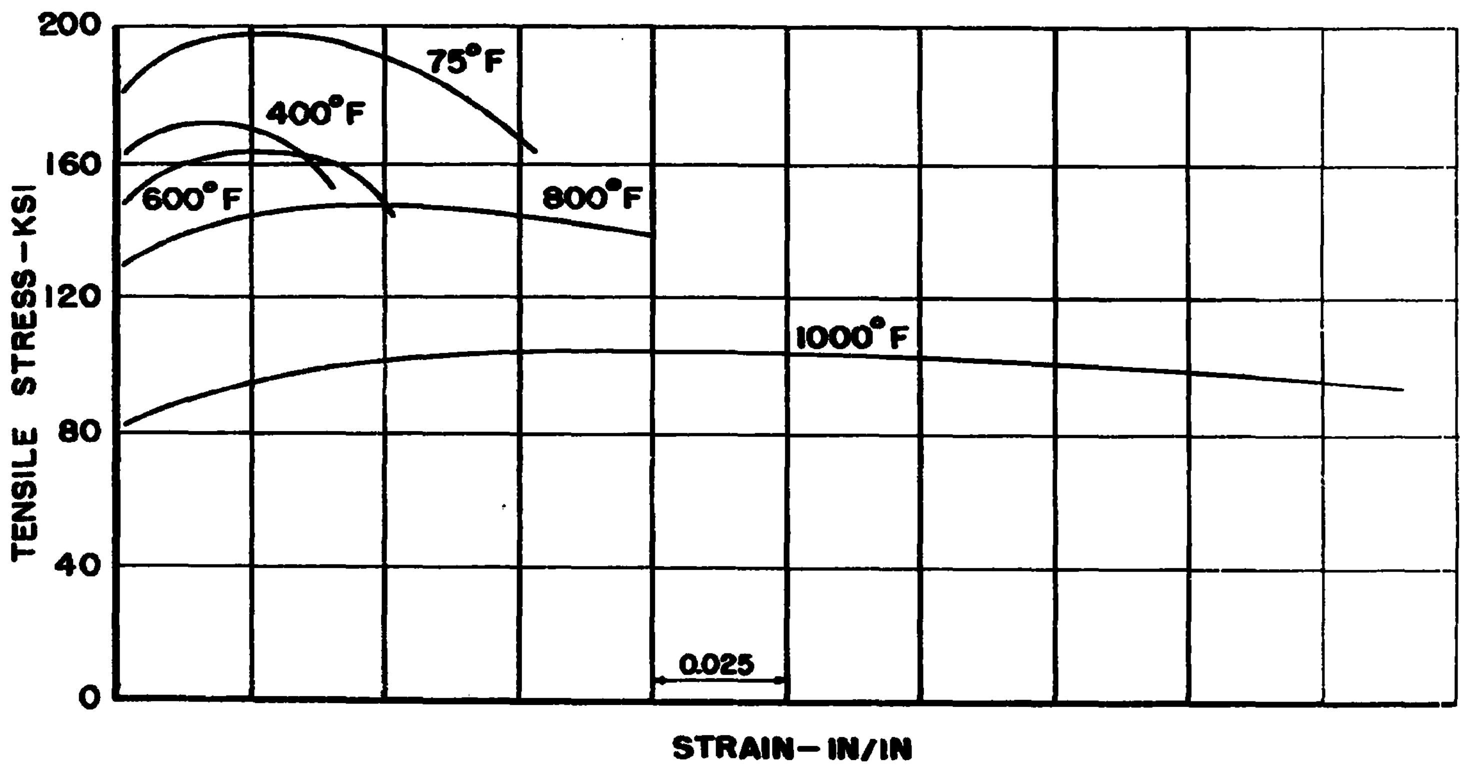


FIGURE 72. TENSILE POSTYIELD STRESS-STRAIN CURVES OF Ph15-7Mo EXPOSED 10 HOURS

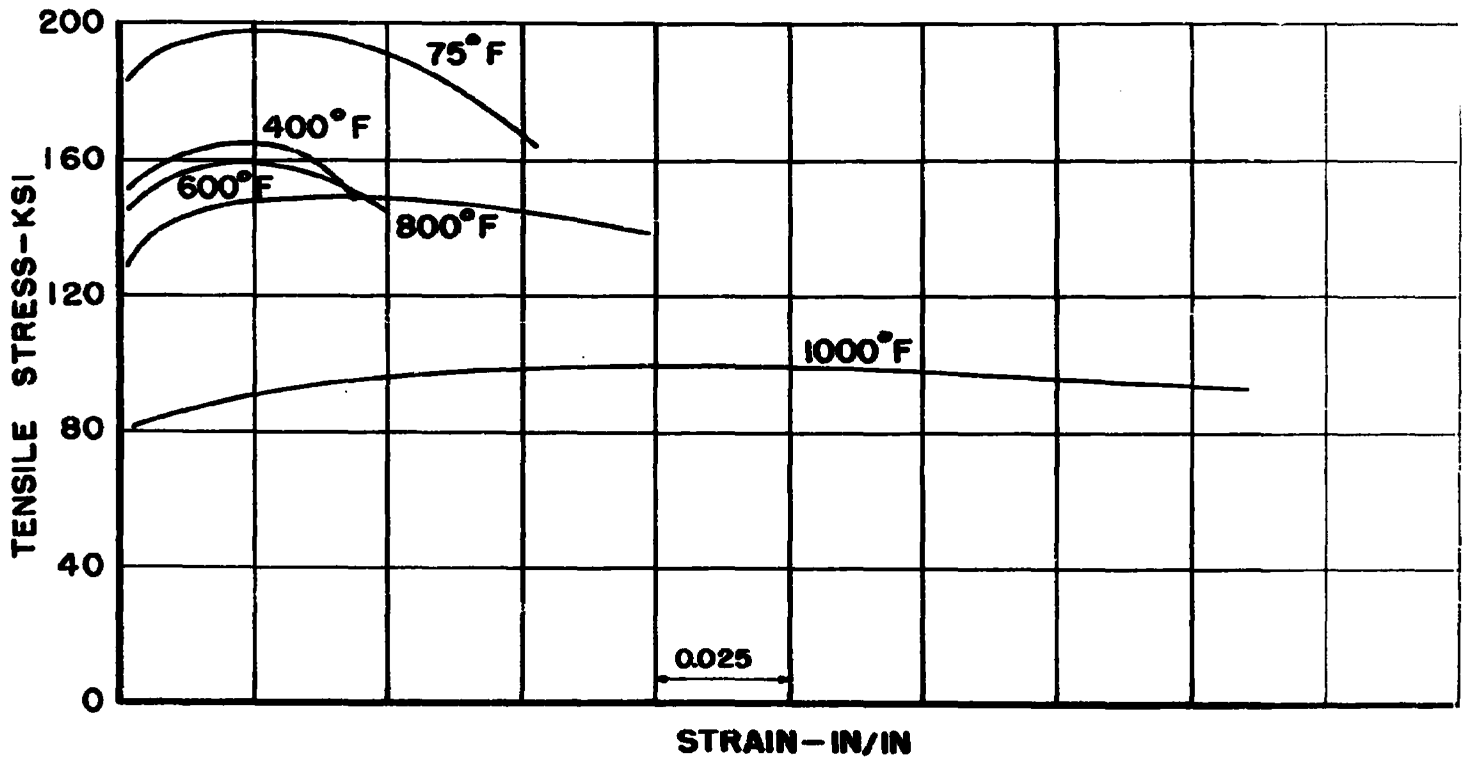


FIGURE 73. TENSILE POSTYIELD STRESS-STRAIN CURVES OF Ph15-7Mo EXPOSED 100 HOURS

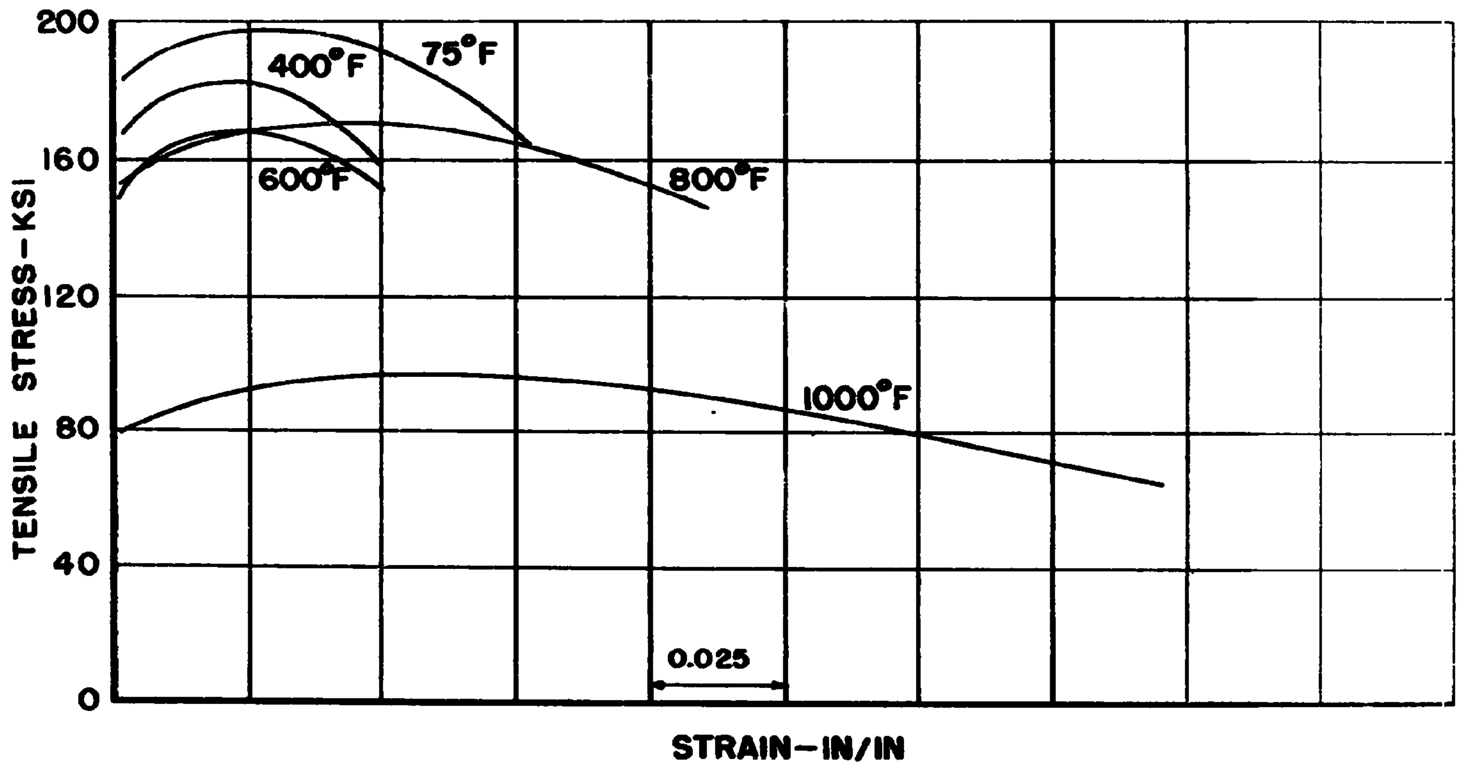


FIGURE 74. TENSILE POSTYIELD STRESS-STRAIN CURVES OF Ph15-7Mo EXPOSED 1000 HOURS

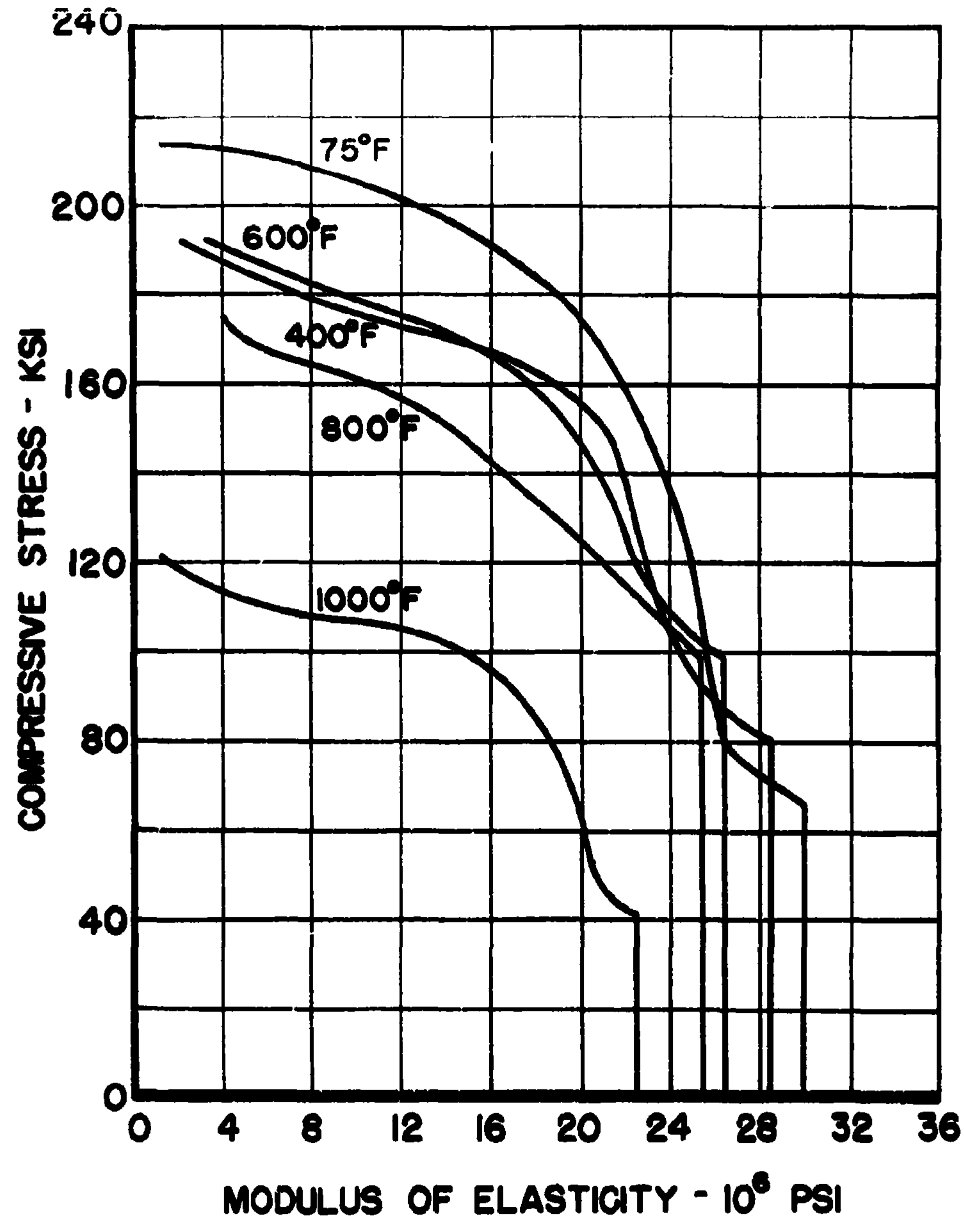


FIGURE 75. COMPRESSIVE TANGENT MODULUS CURVES OF Ph15-7Mo EXPOSED 0.5 HOURS

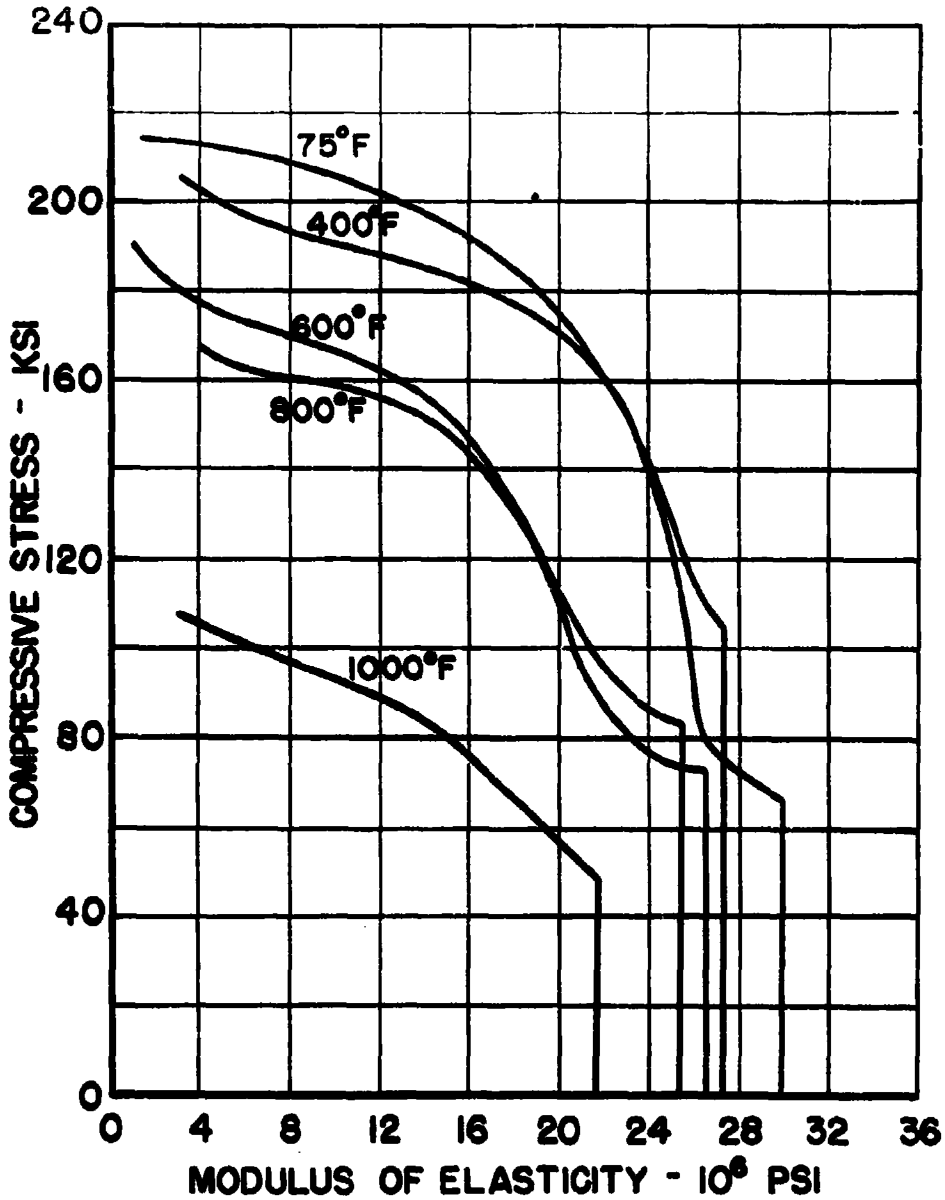


FIGURE 76. COMPRESSIVE TANGENT MODULUS CURVES OF Ph15-7Mo EXPOSED 10 HOURS

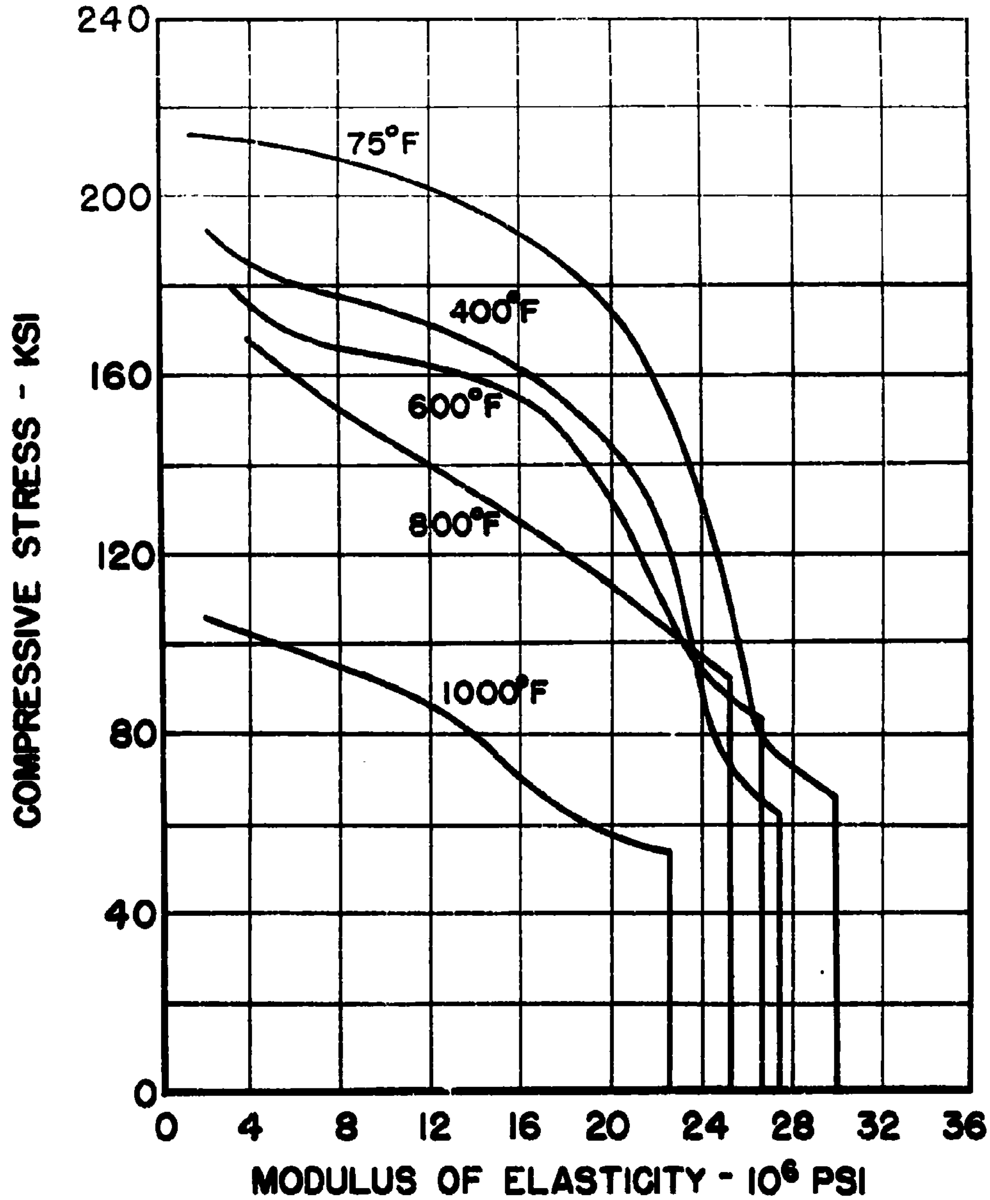


FIGURE 77. COMPRESSIVE TANGENT MODULUS CURVES OF Ph15-7Mo EXPOSED 100 HOURS

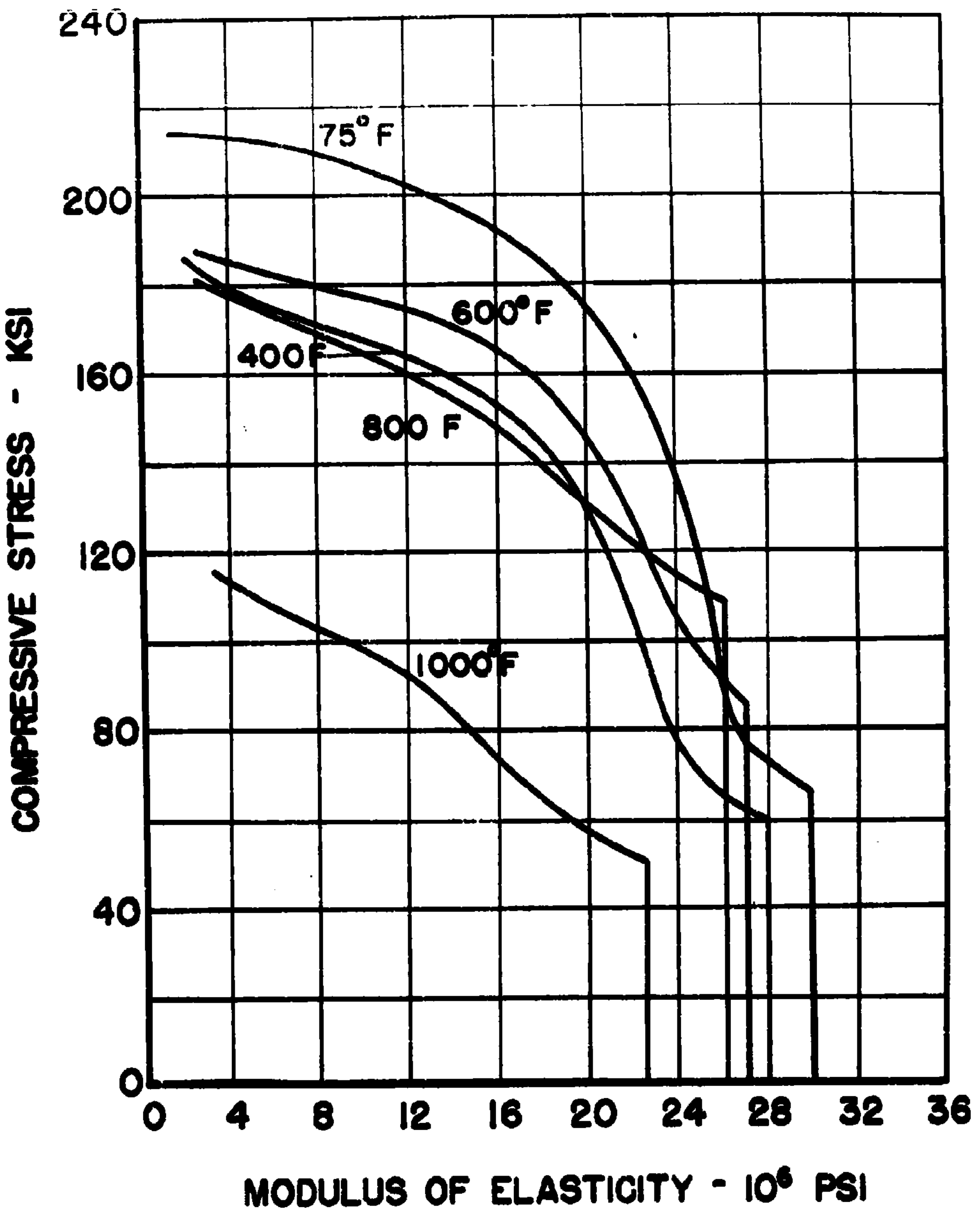


FIGURE 78. COMPRESSIVE TANGENT MODULUS CURVES OF Ph15-7Mo EXPOSED 1000 HOURS

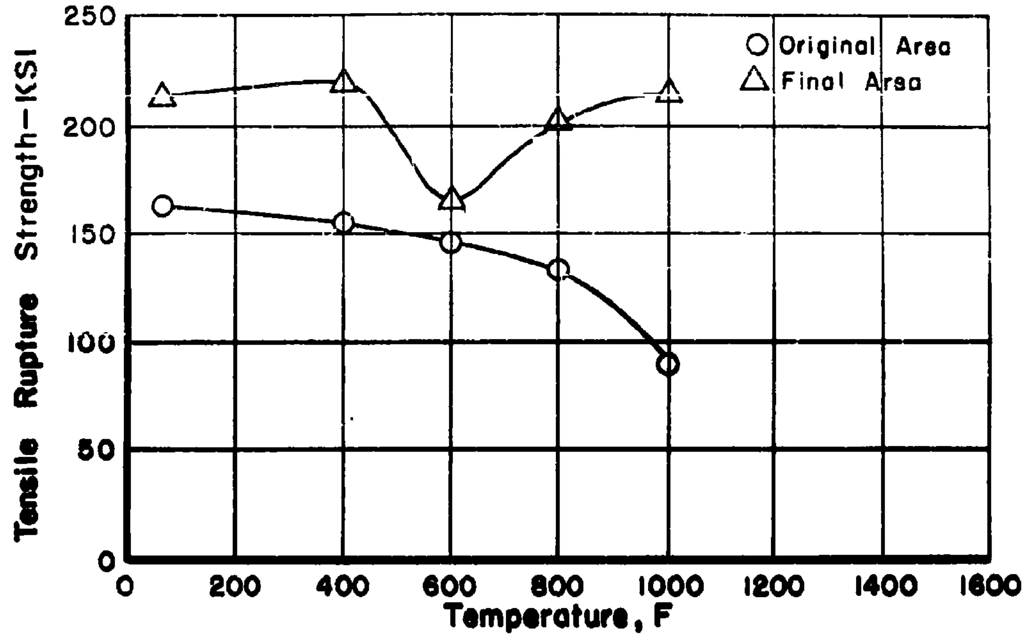


FIGURE 79. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

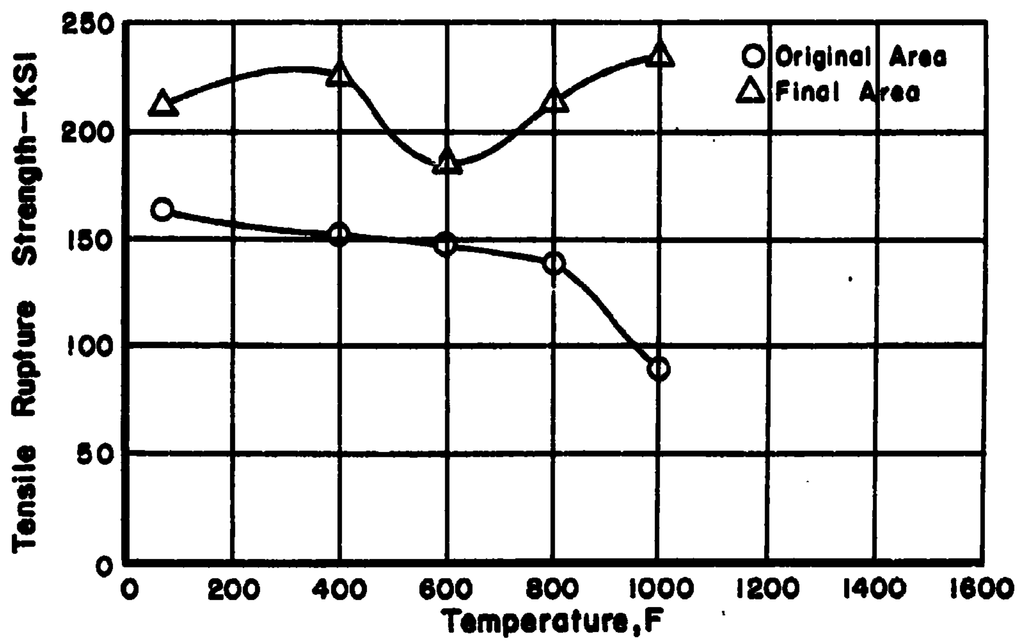


FIGURE 80. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS, BASED ON ORIGINAL AND FINAL AREAS

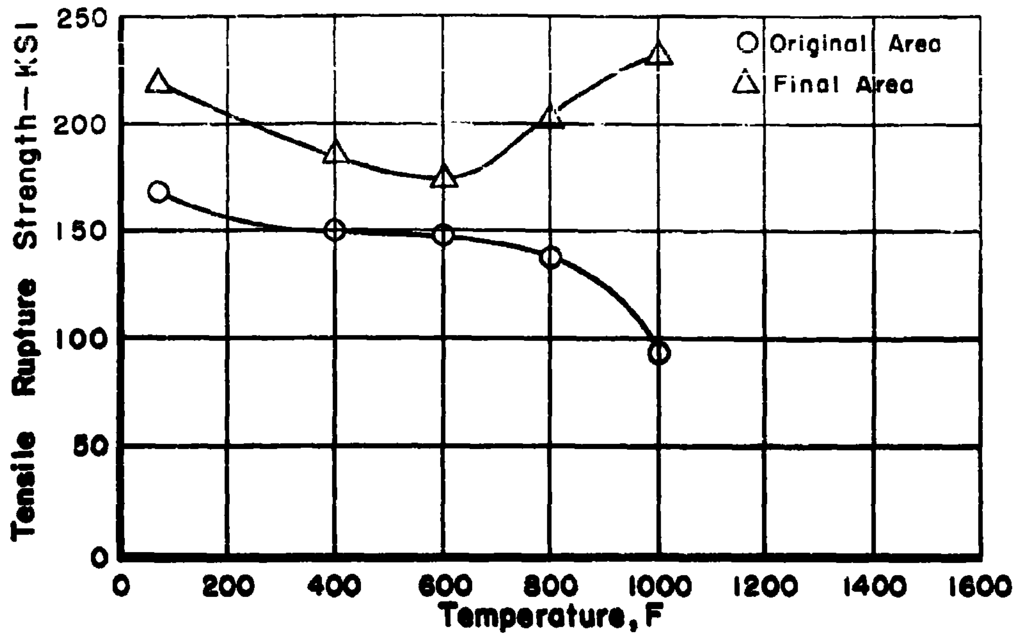


FIGURE 81. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

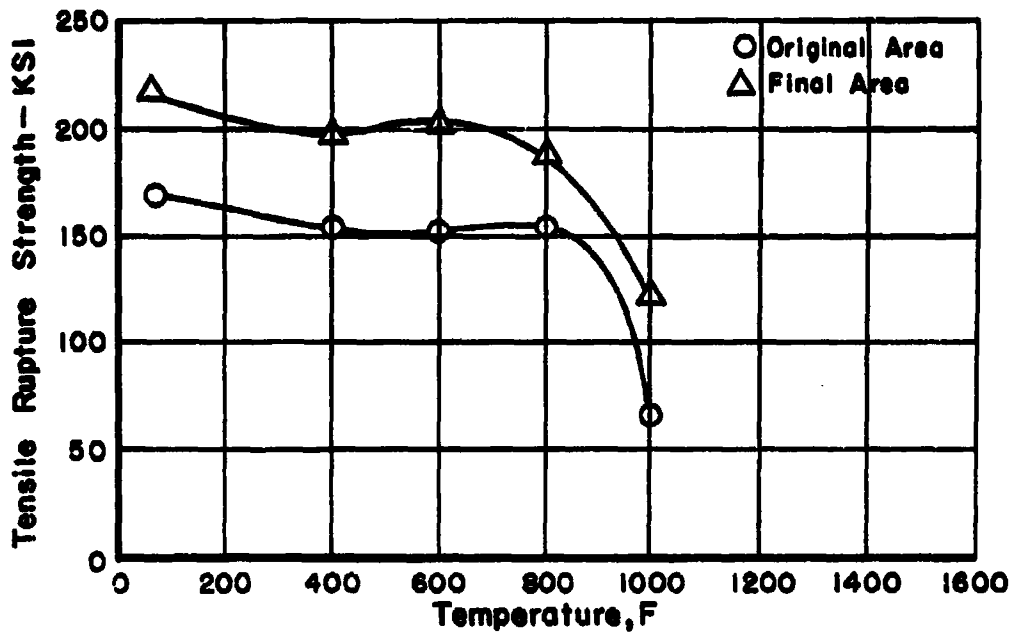


FIGURE 82. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

APPENDIX II

## SUMMARY OF ROOM TEMPERATURE PROPERTIES OF AM 355

**Form:** 0.052 Inch Sheet

**Condition:** SCT 850

**Properties:**

| | | | | |
|---|---|---|---|---|
| Ultimate Tensile Strength | - | $F_{tu}$ | = | 219,950 psi |
| Tensile Yield Strength | - | $F_{ty}$ | = | 183,900 psi |
| Modulus of Elasticity | - | $E$ | = | $29.67 \times 10^6$ psi |
| Percent Elongation in 2 inches | | | = | 13.4 |
| Notched Tensile Strength | - | $F_{tu}$ | = | 250,690 psi |
| Compressive Yield Strength | - | $F_{cy}$ | = | 216,790 psi |
| Compressive Modulus of Elasticity | - | $E_c$ | = | $30.00 \times 10^6$ psi |
| Ultimate Bearing Strength | | | | |
| (e/D = 1.5) | - | $F_{bru}$ | = | 386,270 psi |
| (e/D = 2.0) | - | $F_{bru}$ | = | 498,670 psi |
| Bearing Yield Strength | | | | |
| (e/D = 1.5) | - | $F_{bry}$ | = | 321,870 psi |
| (e/D = 2.0) | - | $F_{bry}$ | = | 400,270 psi |
| Ultimate Shear Strength | - | $F_{su}$ | = | 137,620 psi |

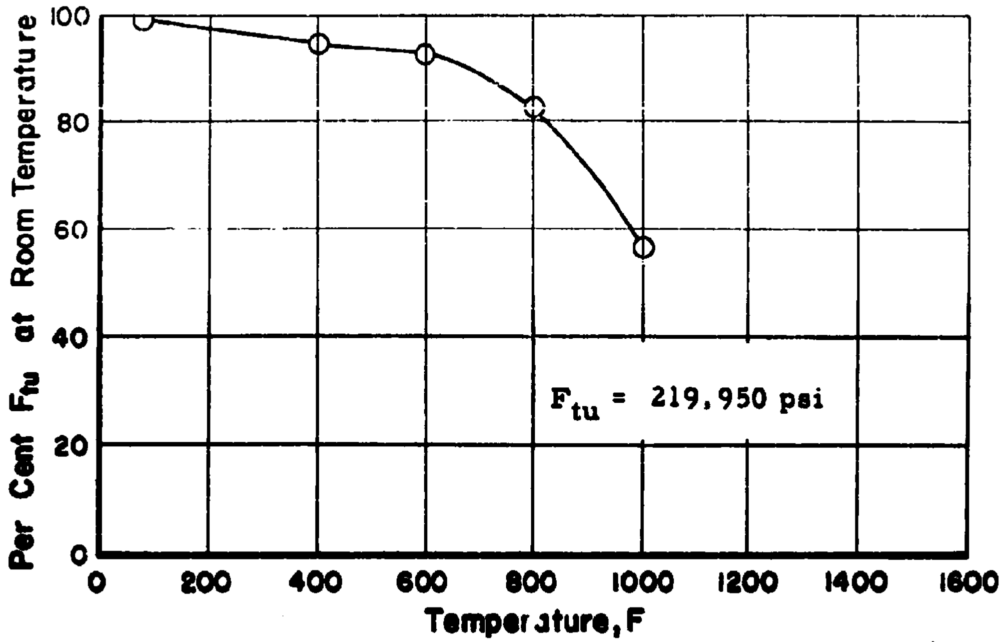


FIGURE 83. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 0.5 HOURS

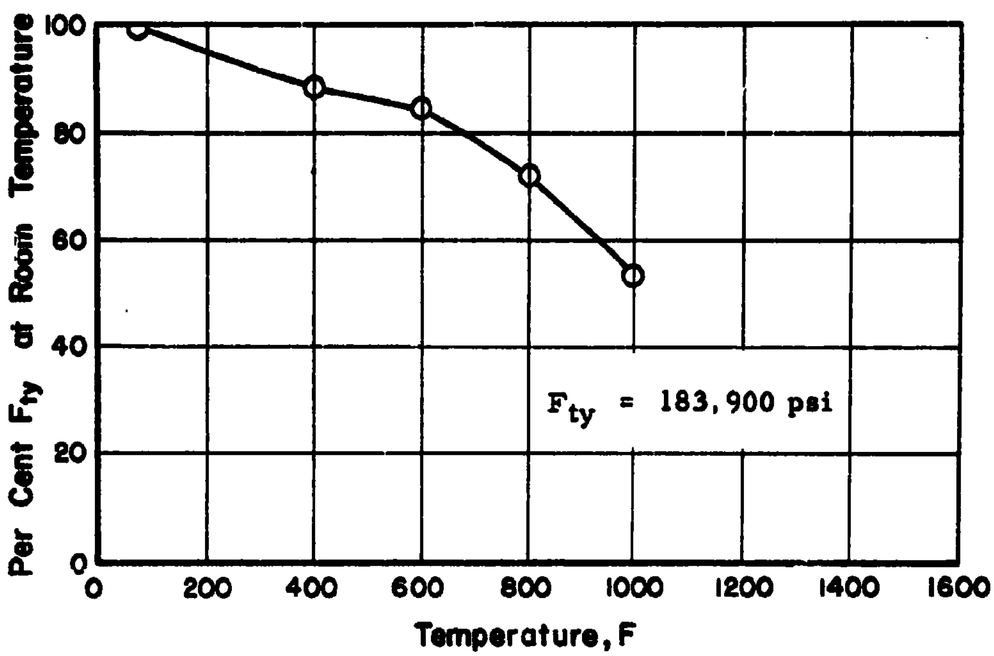


FIGURE 84. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF AM 355 EXPOSED 0.5 HOURS

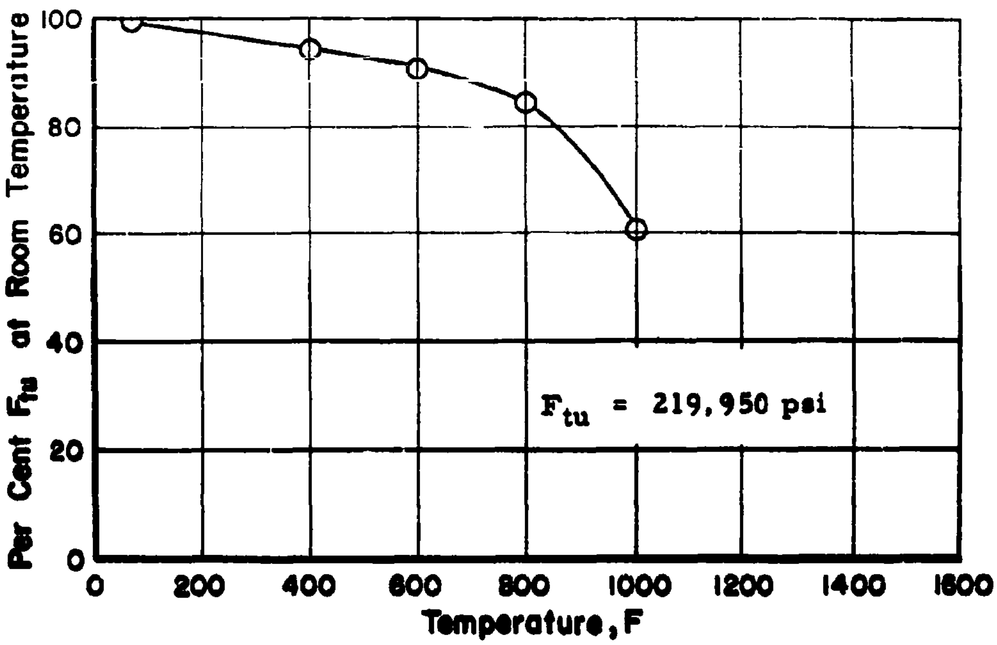


FIGURE 85. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 10 HOURS

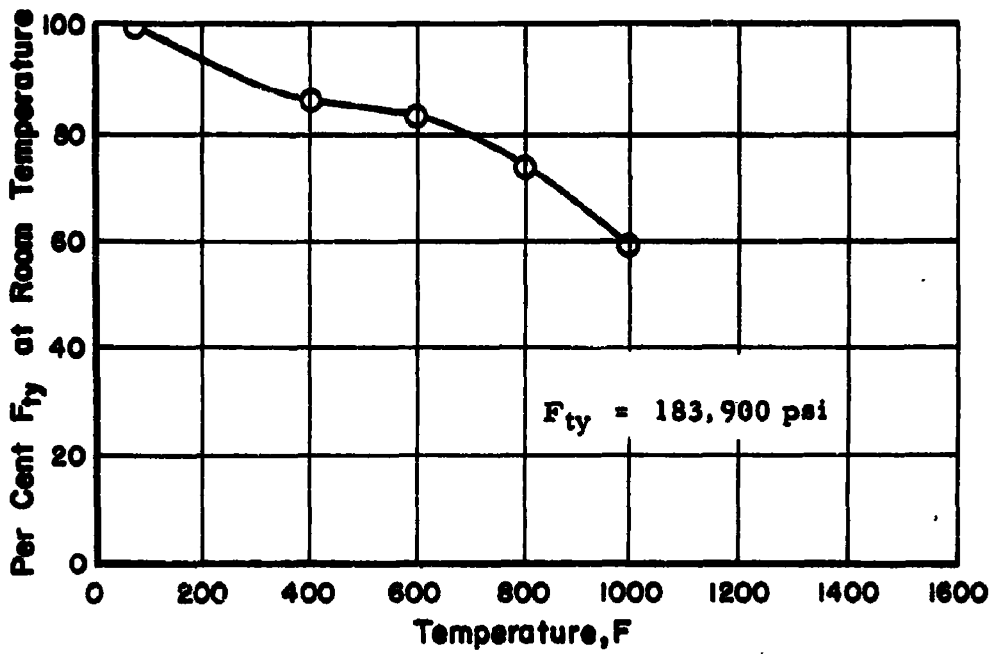


FIGURE 86. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF AM 355 EXPOSED 10 HOURS

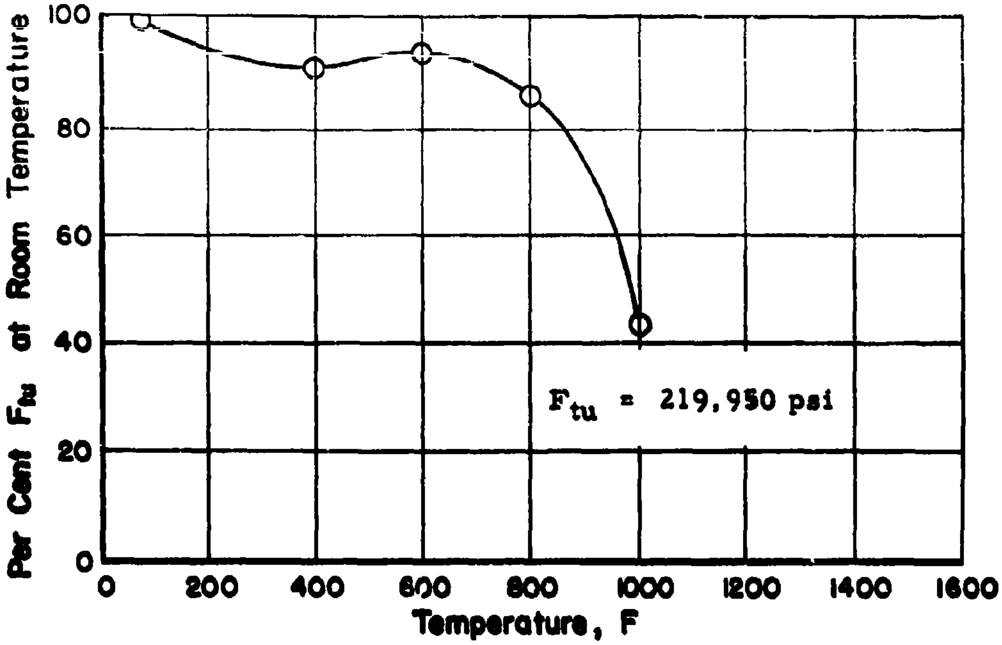


FIGURE 87. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 100 HOURS

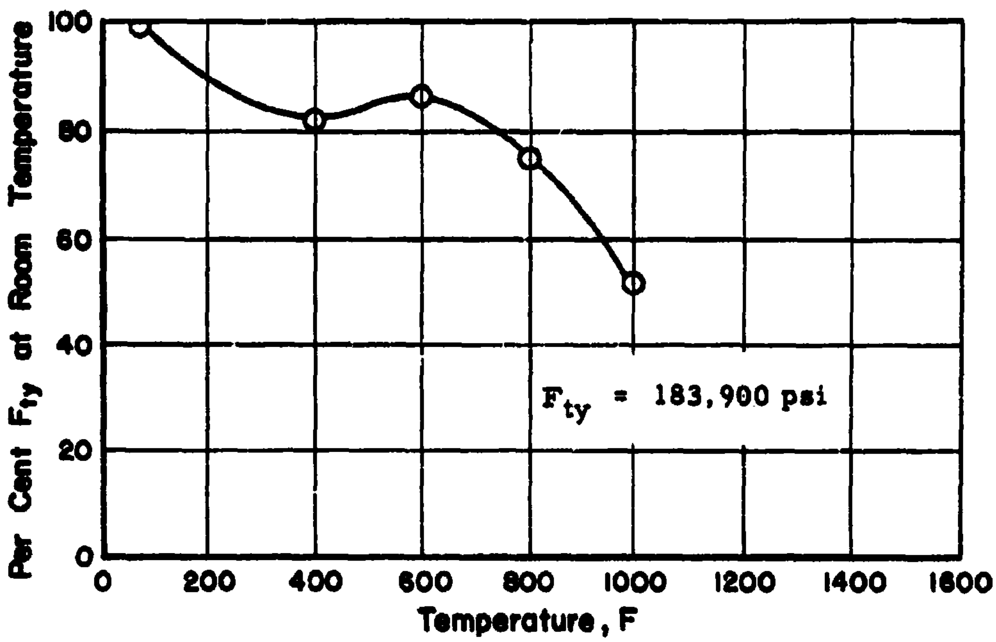


FIGURE 88. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF AM 355 EXPOSED 100 HOURS

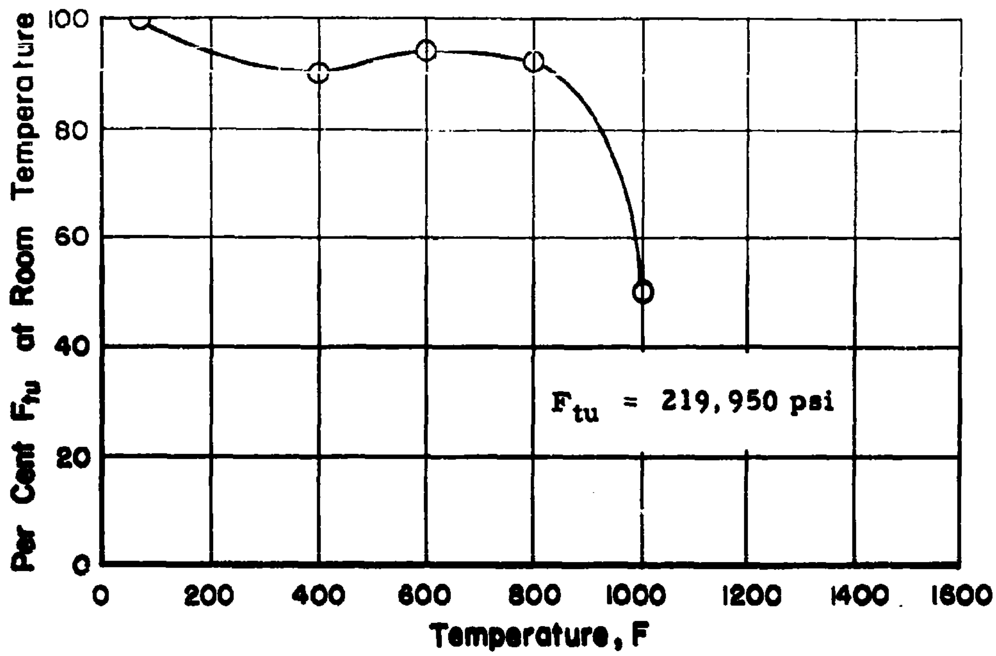


FIGURE 89. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 1000 HOURS

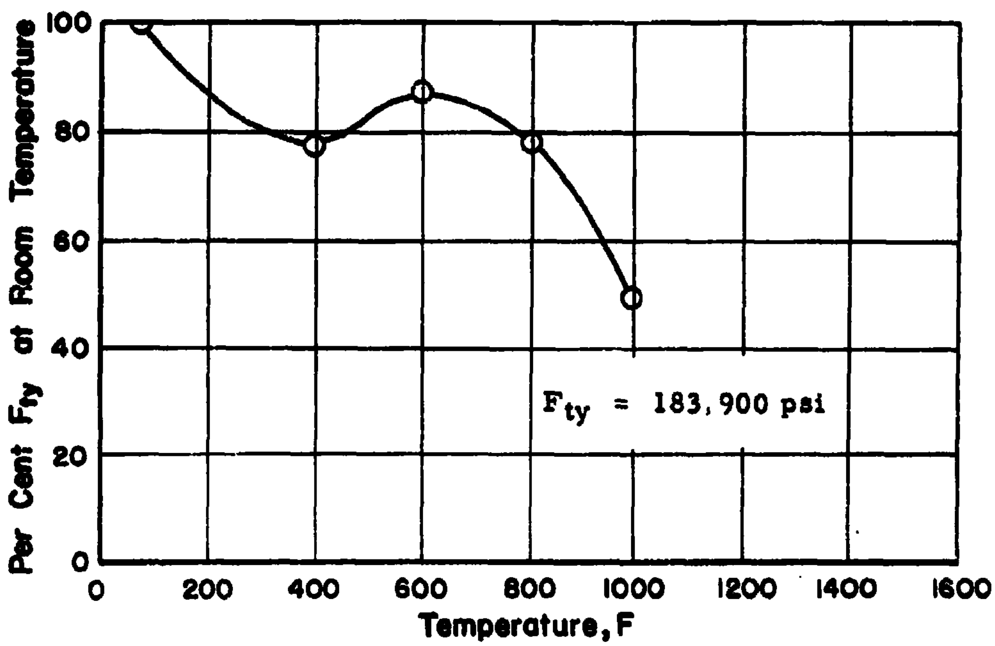


FIGURE 90. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF AM 355 EXPOSED 1000 HOURS

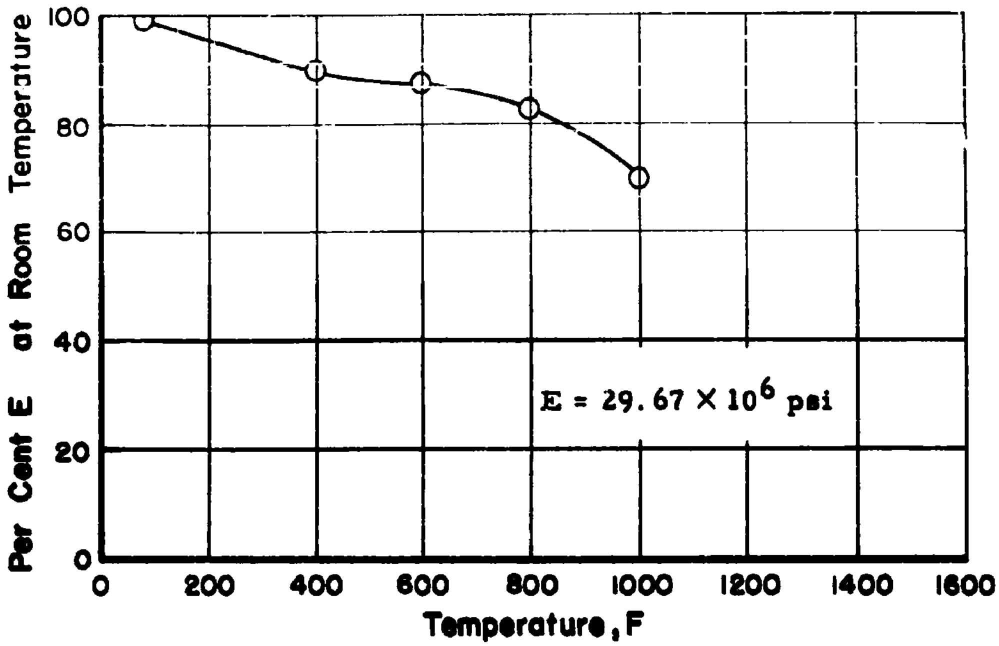


FIGURE 91. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF AM 355 EXPOSED 0.5 HOURS

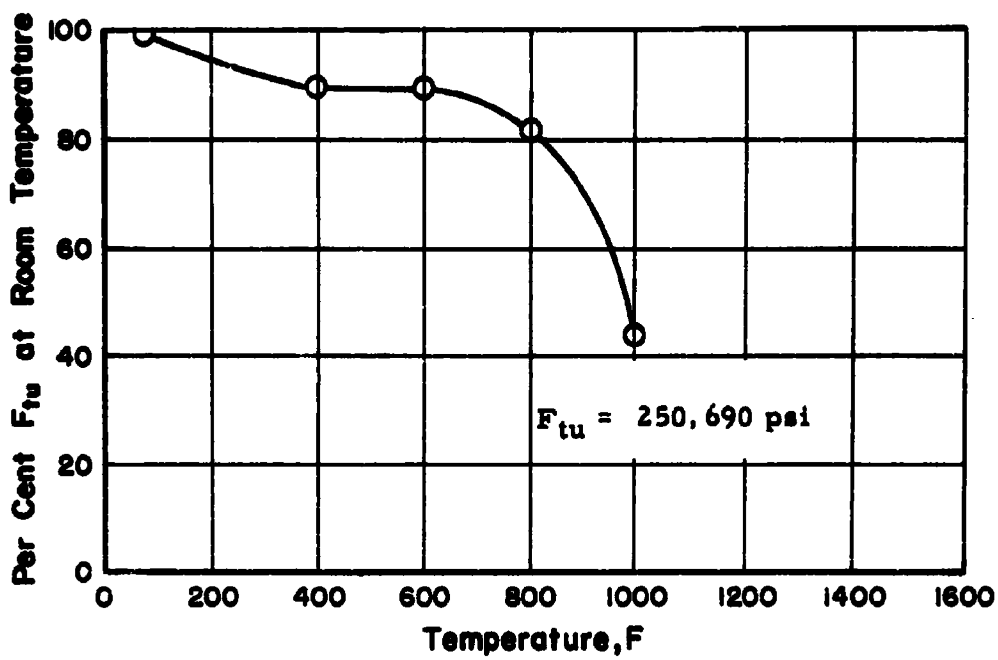


FIGURE 92. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 0.5 HOURS

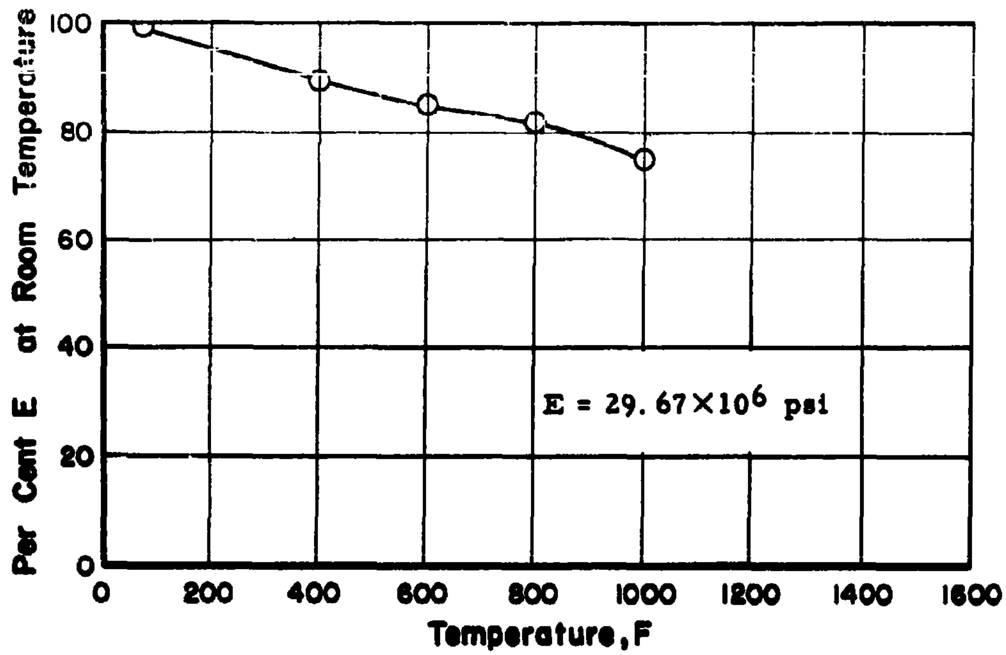


FIGURE 93. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF AM 355 EXPOSED 10 HOURS

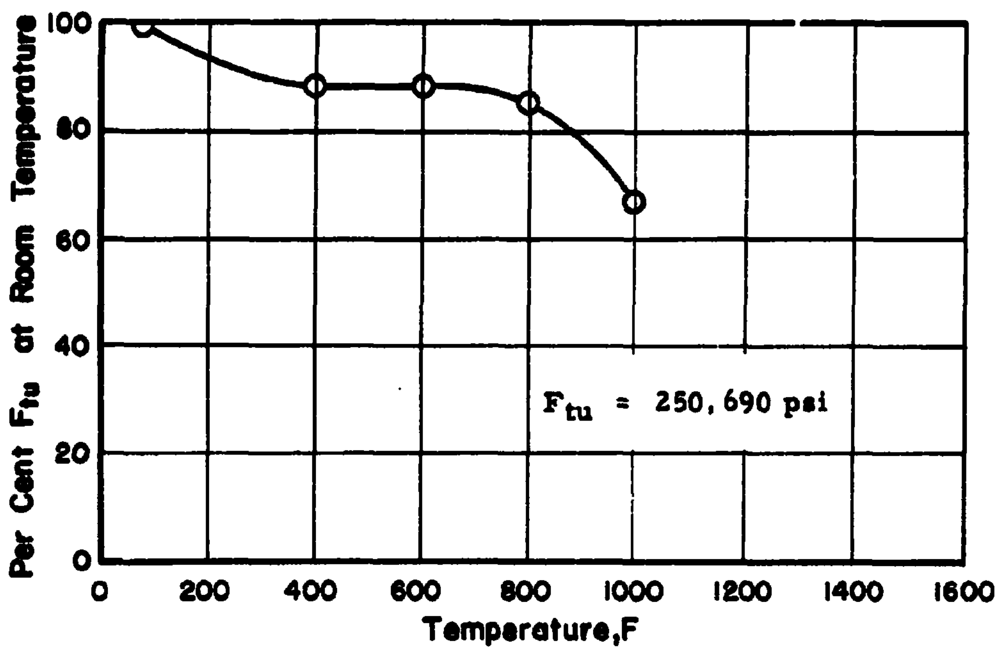


FIGURE 94. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 10 HOURS

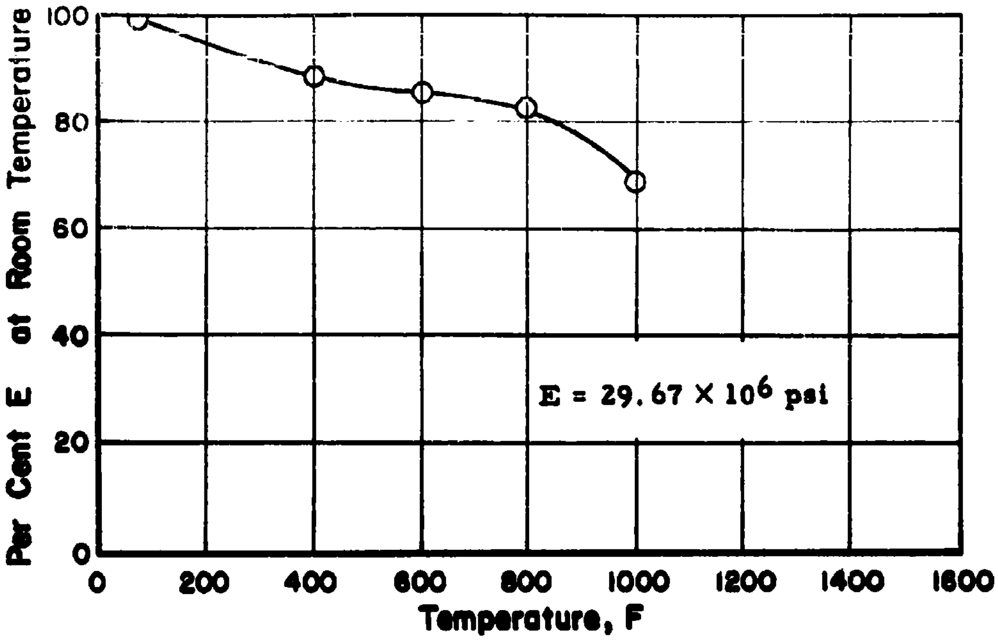


FIGURE 95. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF AM 355 EXPOSED 100 HOURS

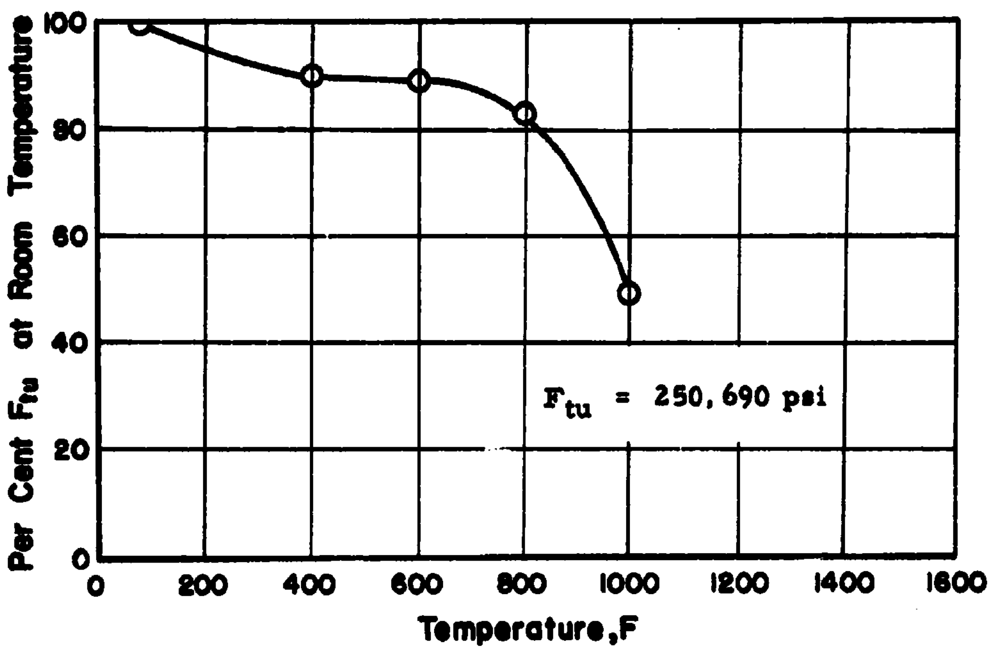


FIGURE 96. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 100 HOURS

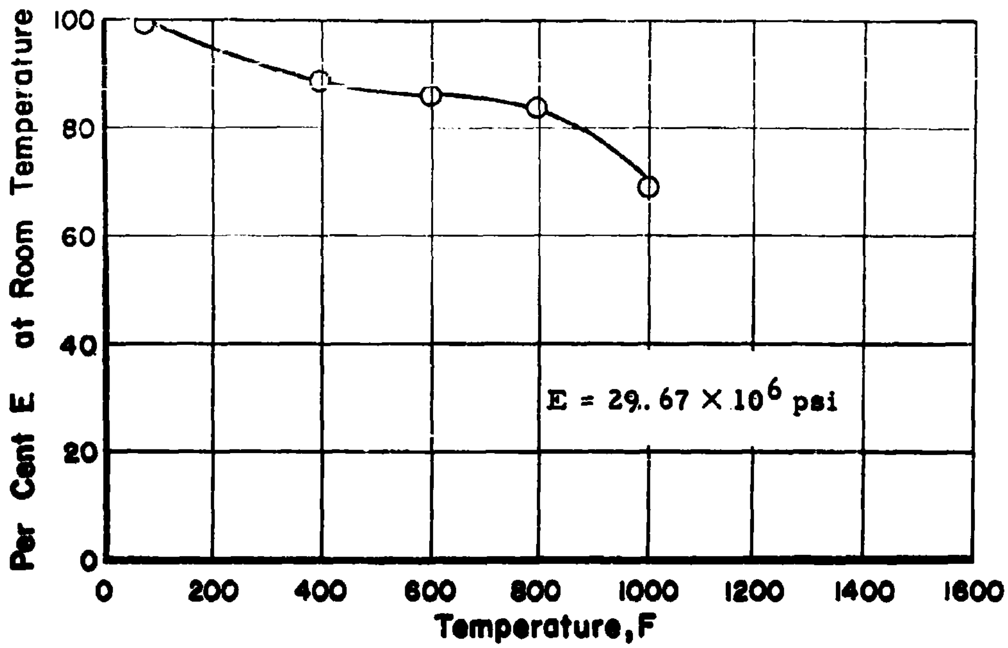


FIGURE 97. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF AM 355 EXPOSED 1000 HOURS

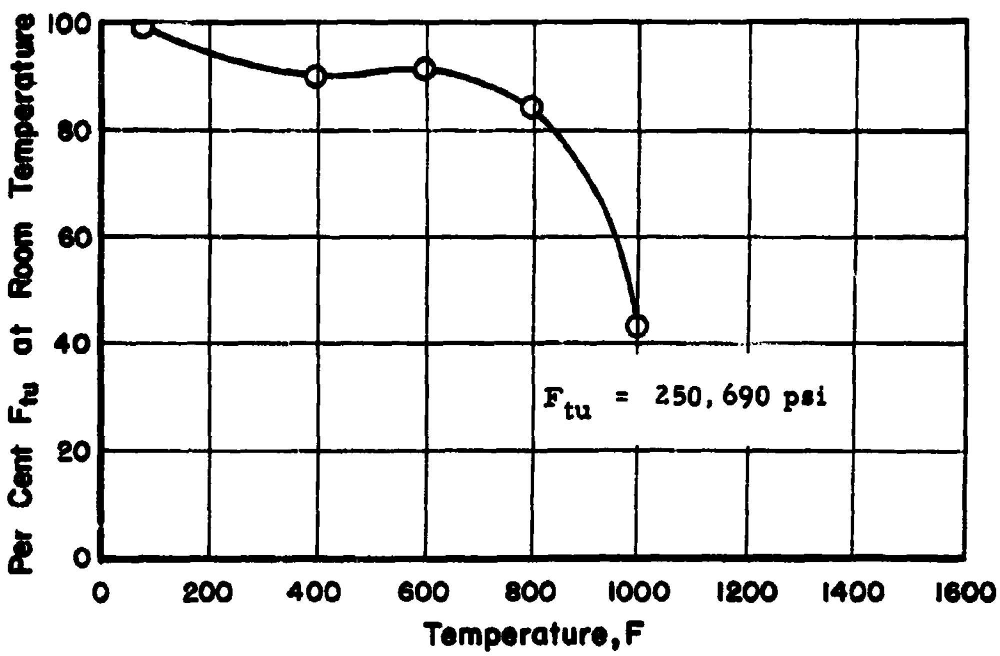


FIGURE 98. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 1000 HOURS

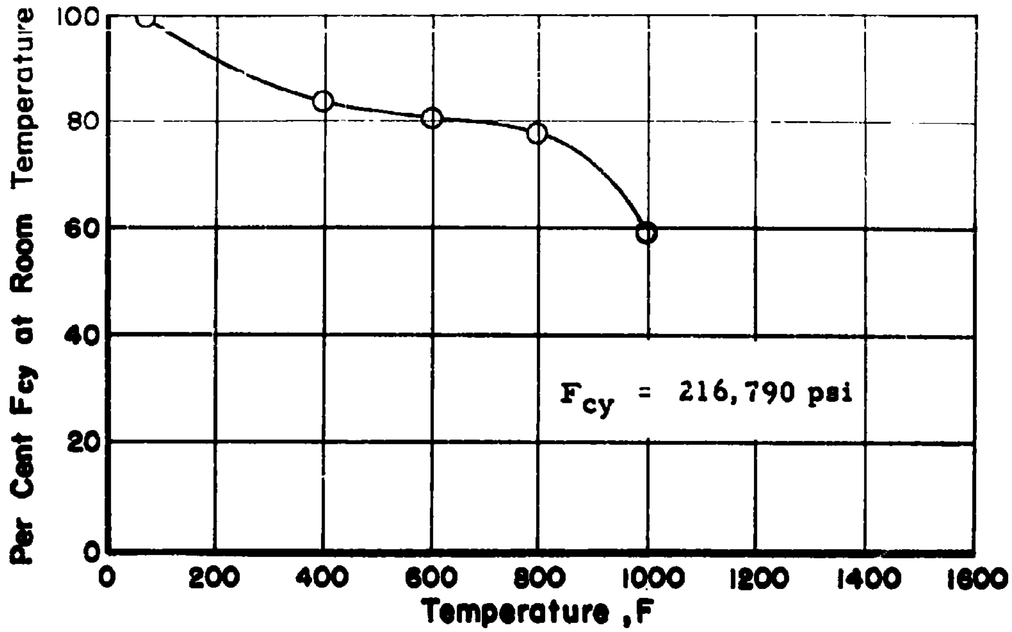


FIGURE 99. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF AM 355 EXPOSED 0.5 HOURS

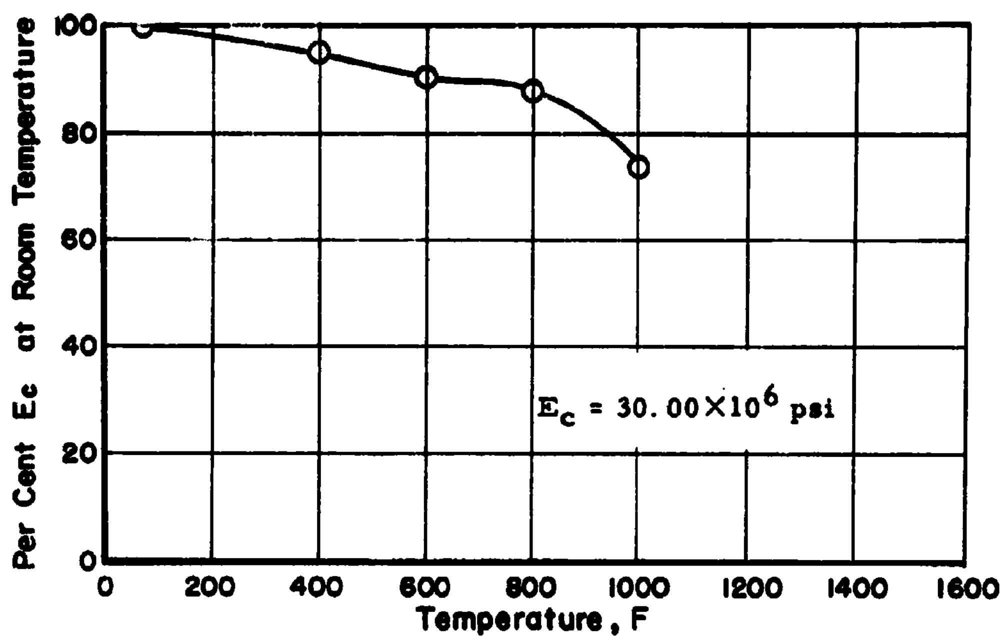


FIGURE 100. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF AM 355 EXPOSED 0.5 HOURS

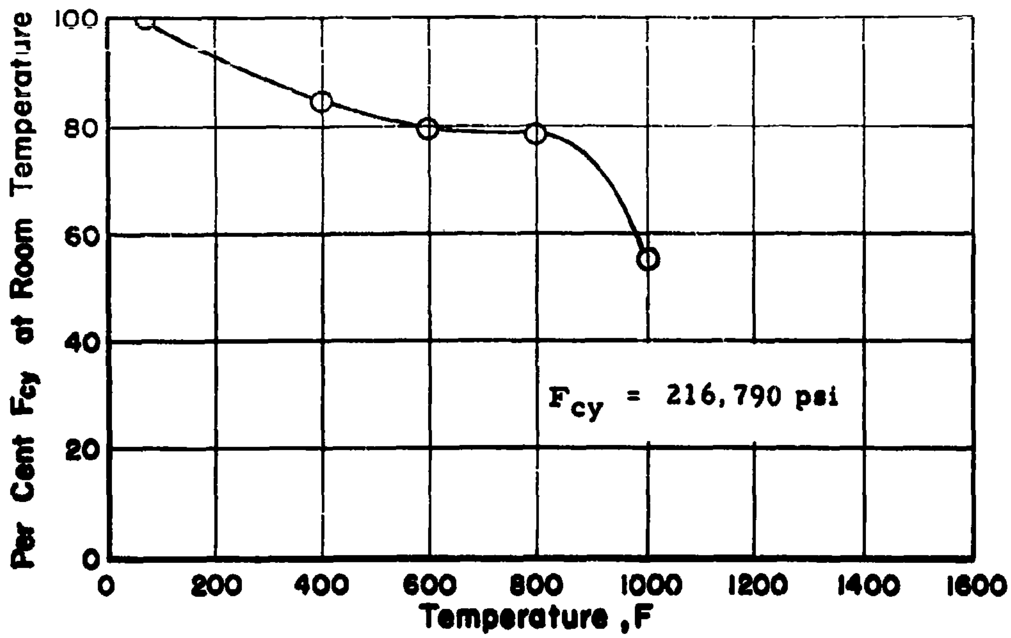


FIGURE 101. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF AM 355 EXPOSED 10 HOURS

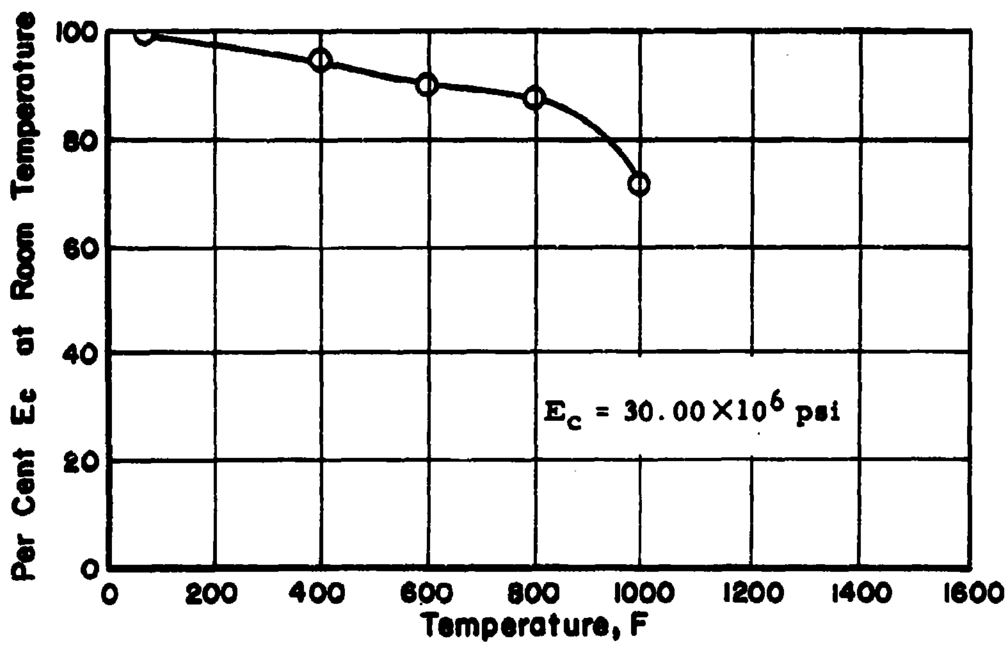


FIGURE 102. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF AM 355 EXPOSED 10 HOURS

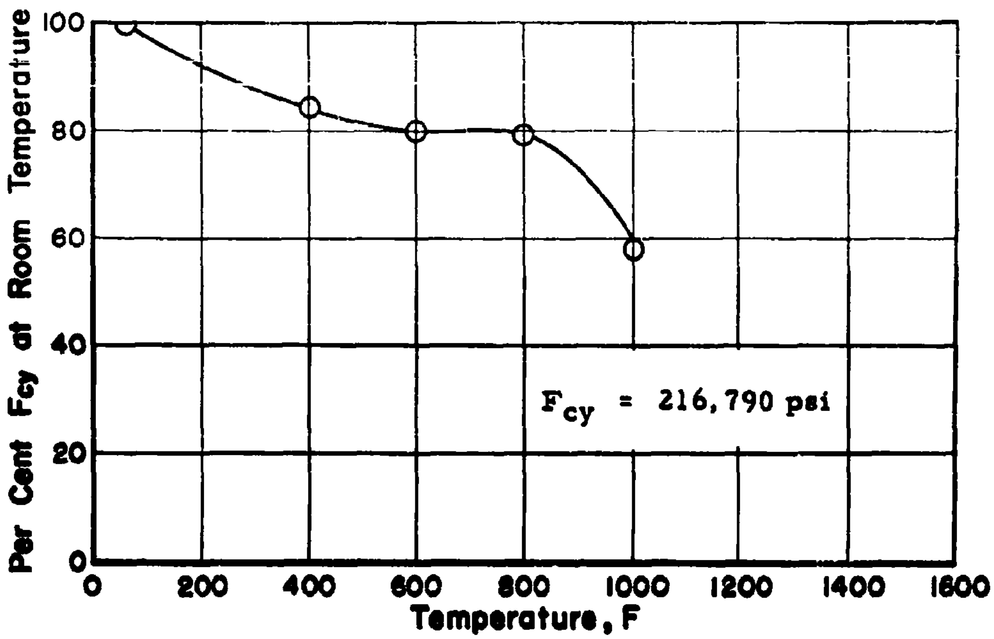


FIGURE 103. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF AM 355 EXPOSED 100 HOURS

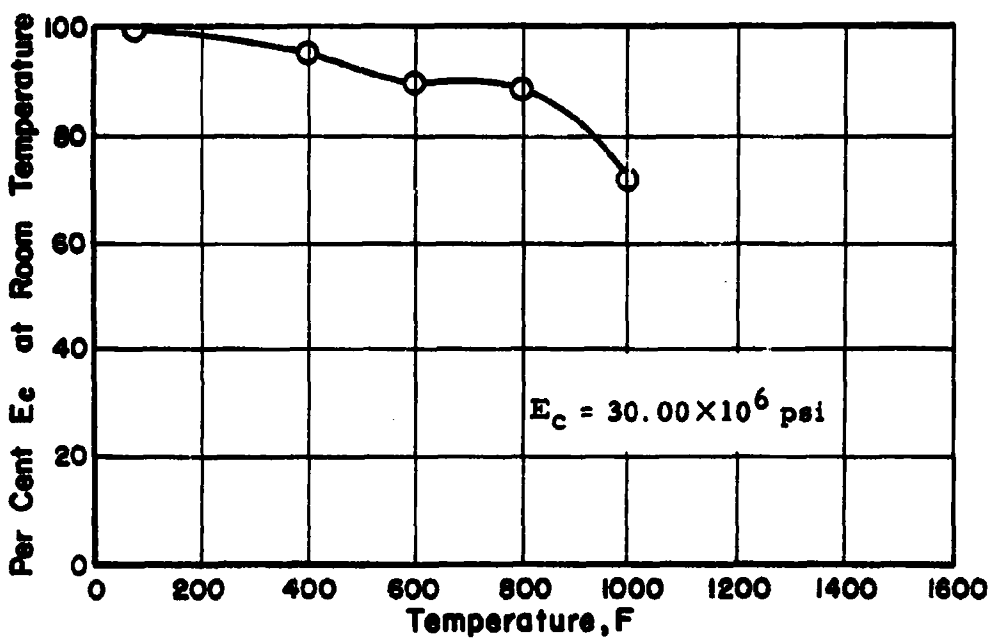


FIGURE 104. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF AM 355 EXPOSED 100 HOURS

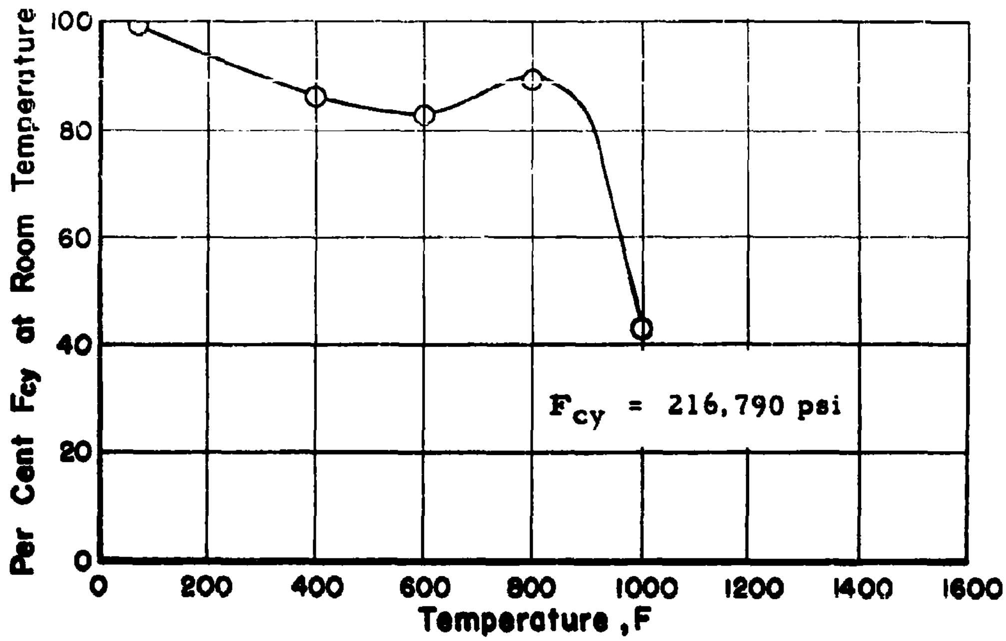


FIGURE 105. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF AM 355 EXPOSED 1000 HOURS

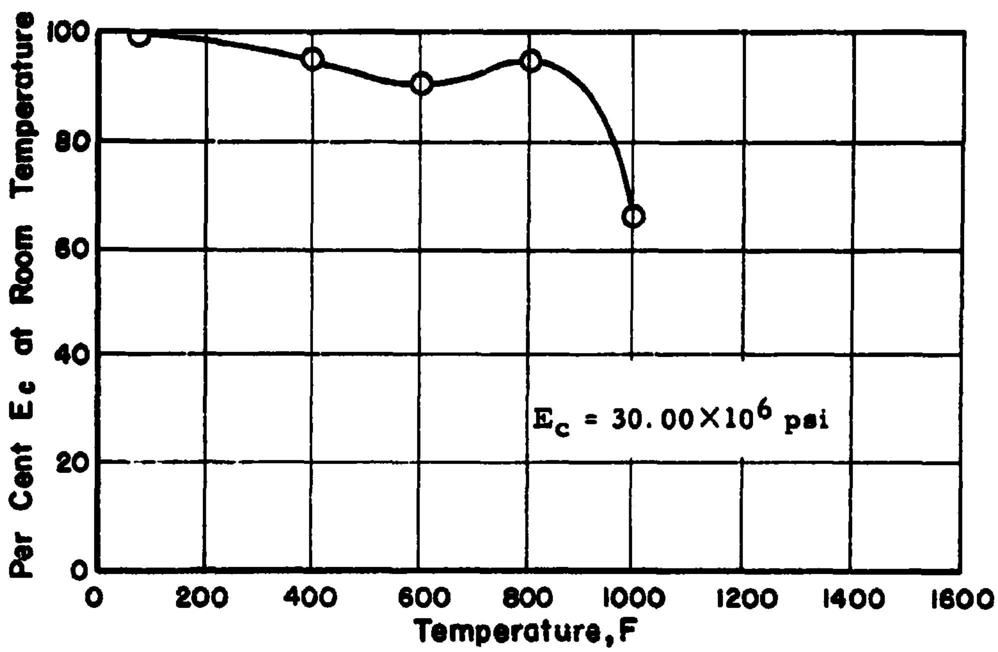


FIGURE 106. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF AM 355 EXPOSED 1000 HOURS

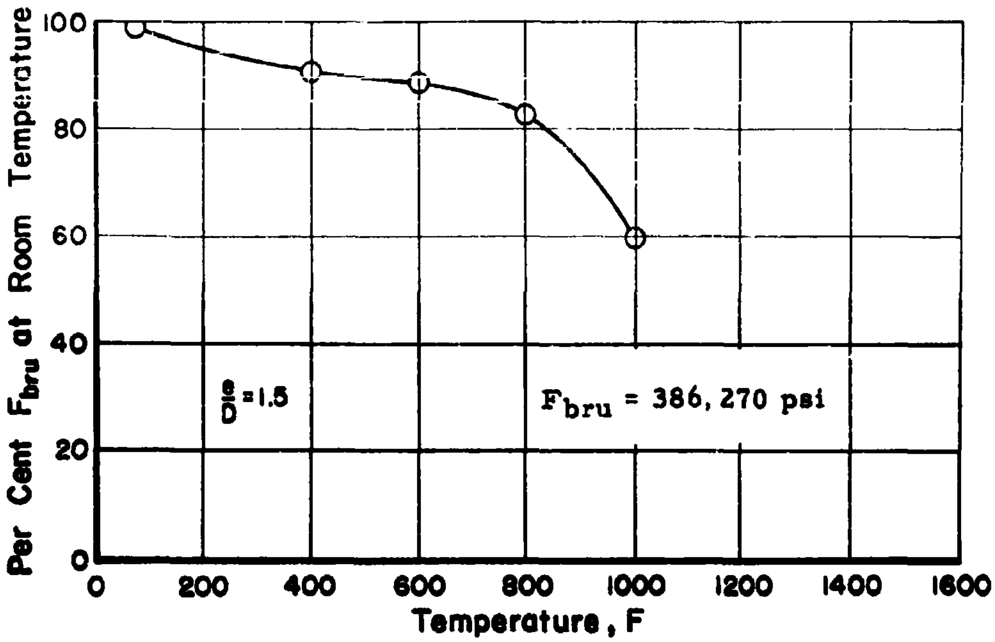


FIGURE 107. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 0.5 HOURS

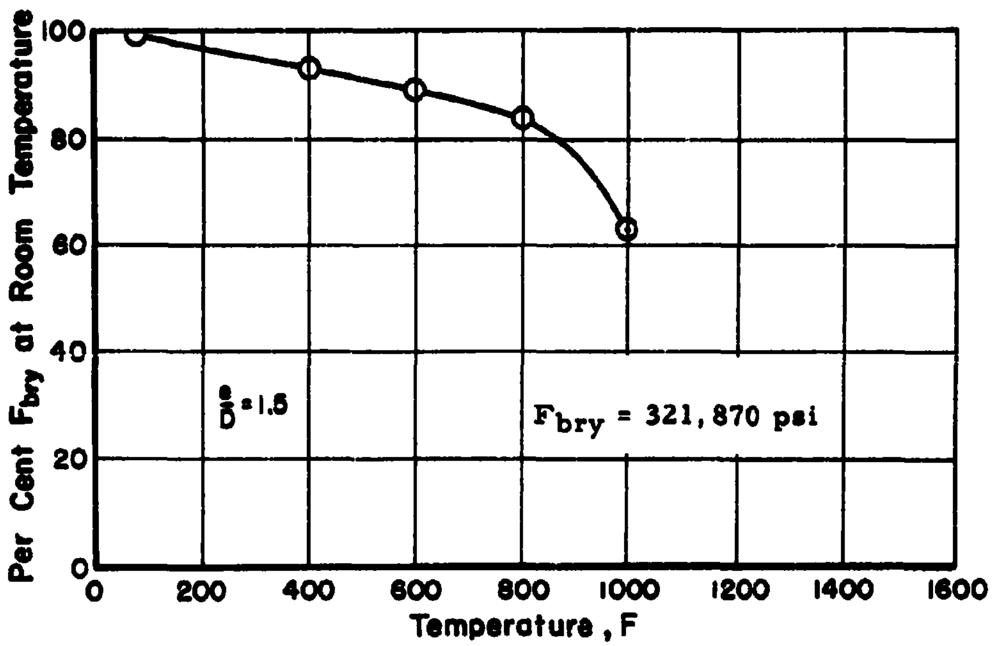


FIGURE 108. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 0.5 HOURS

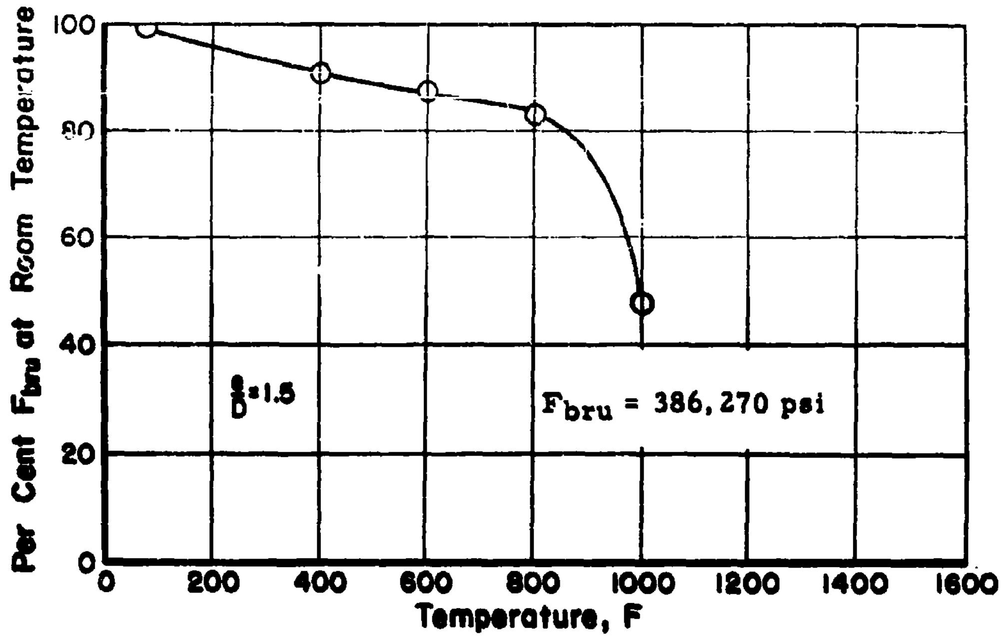


FIGURE 109. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 10 HOURS

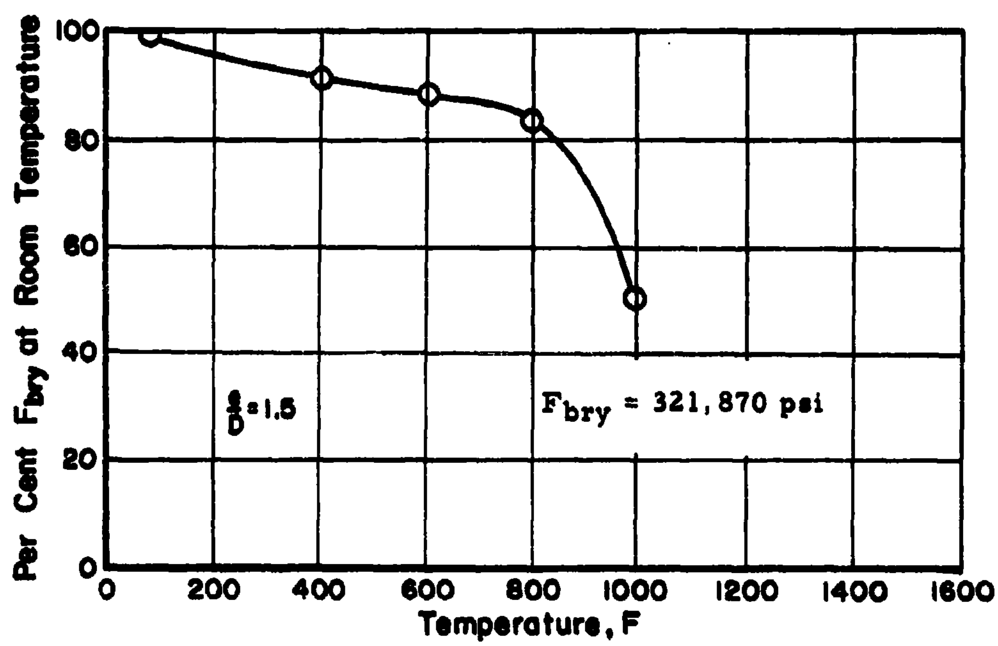


FIGURE 110. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 10 HOURS

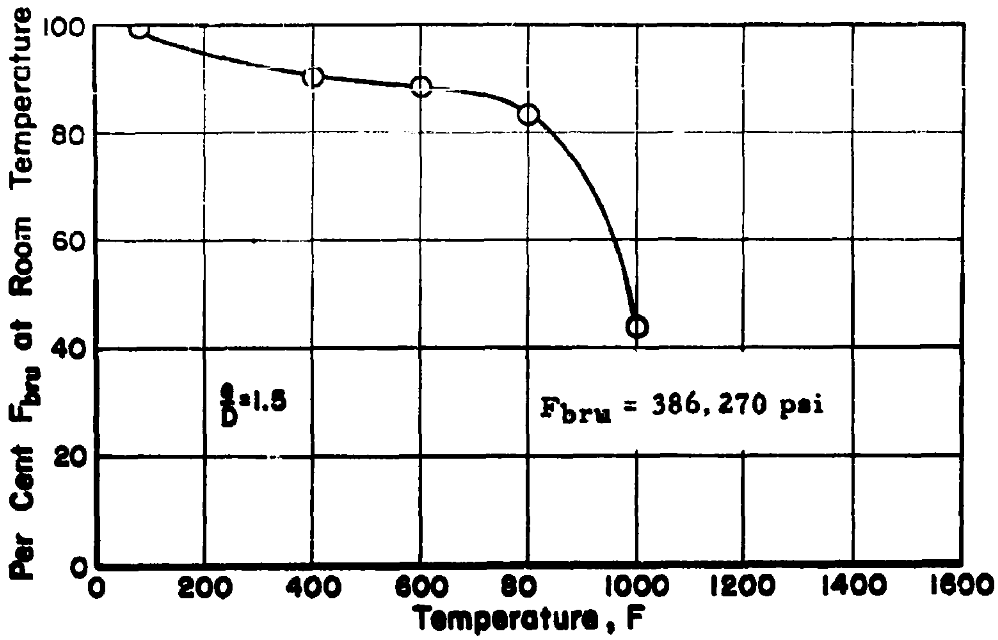


FIGURE 111. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 100 HOURS

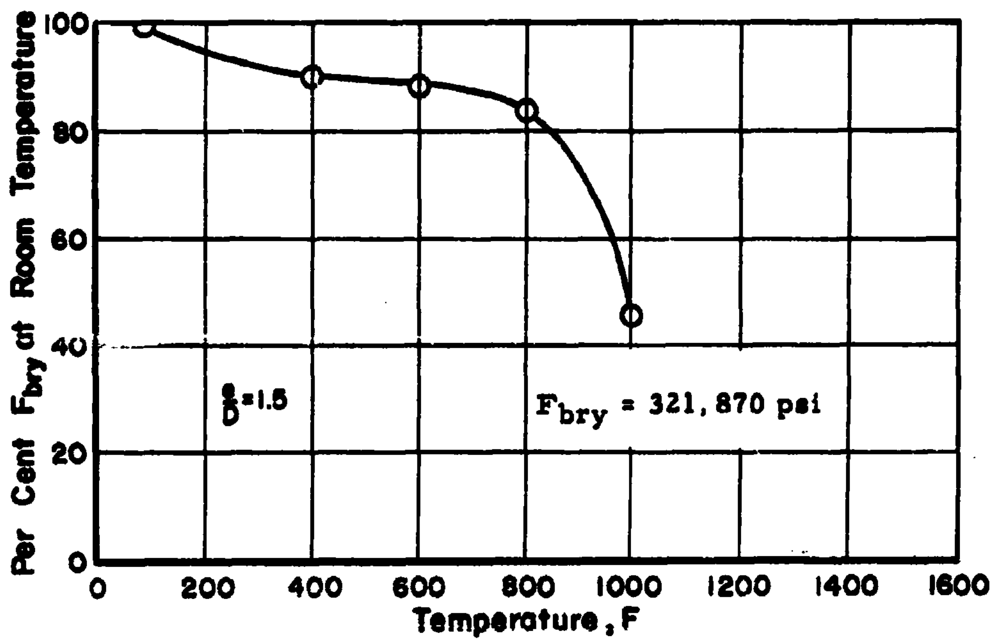


FIGURE 112. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 100 HOURS

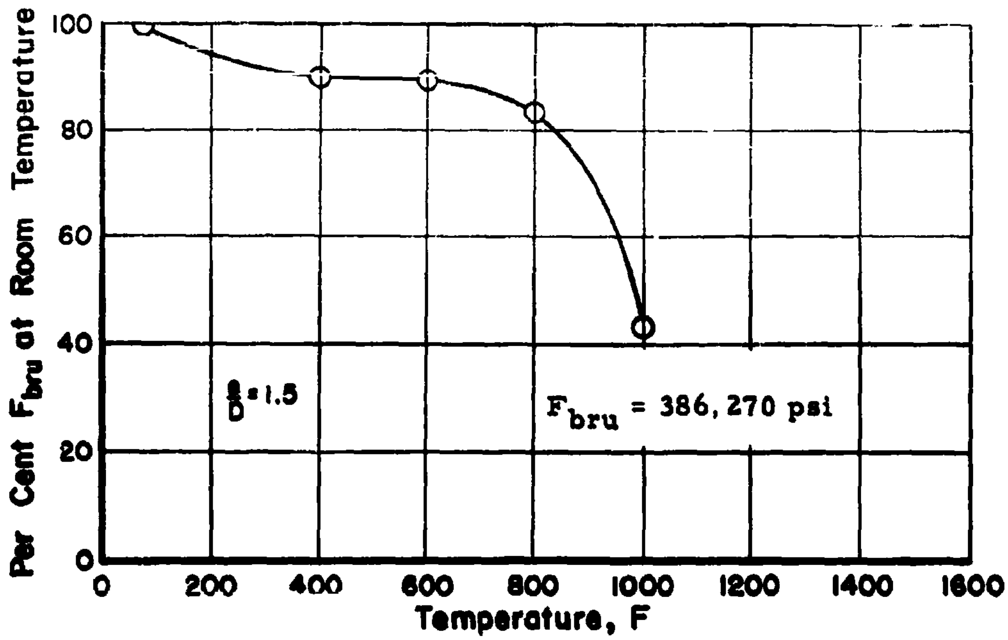


FIGURE 113. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 1000 HOURS

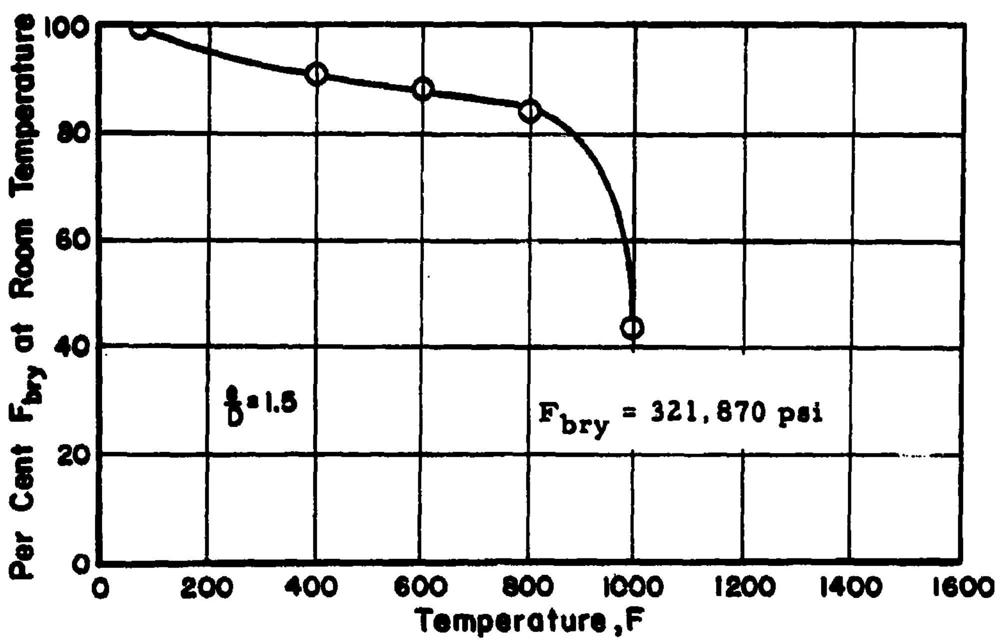


FIGURE 114. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 1000 HOURS

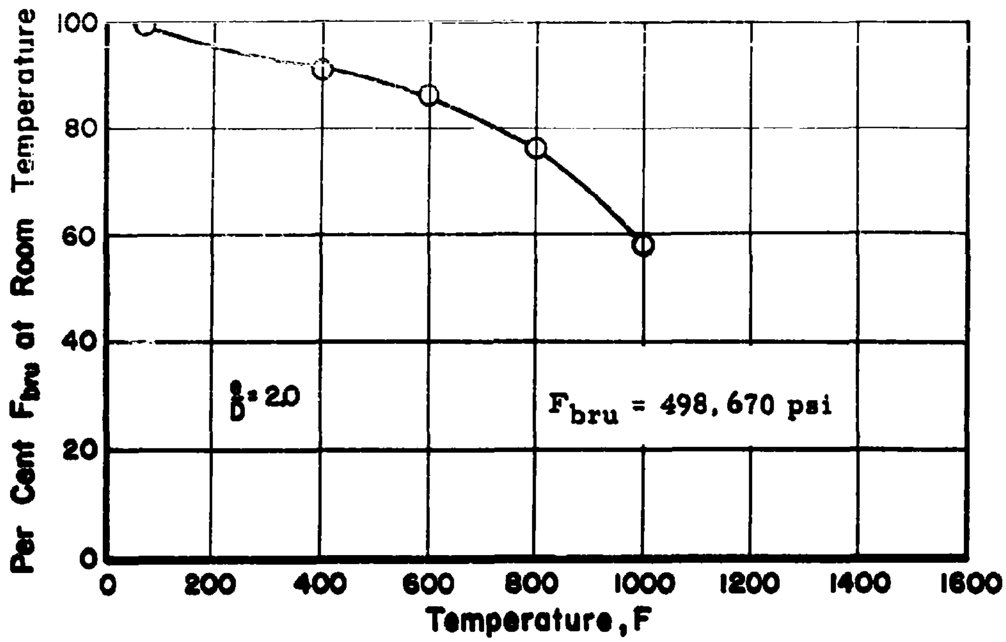


FIGURE 115. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 0.5 HOURS

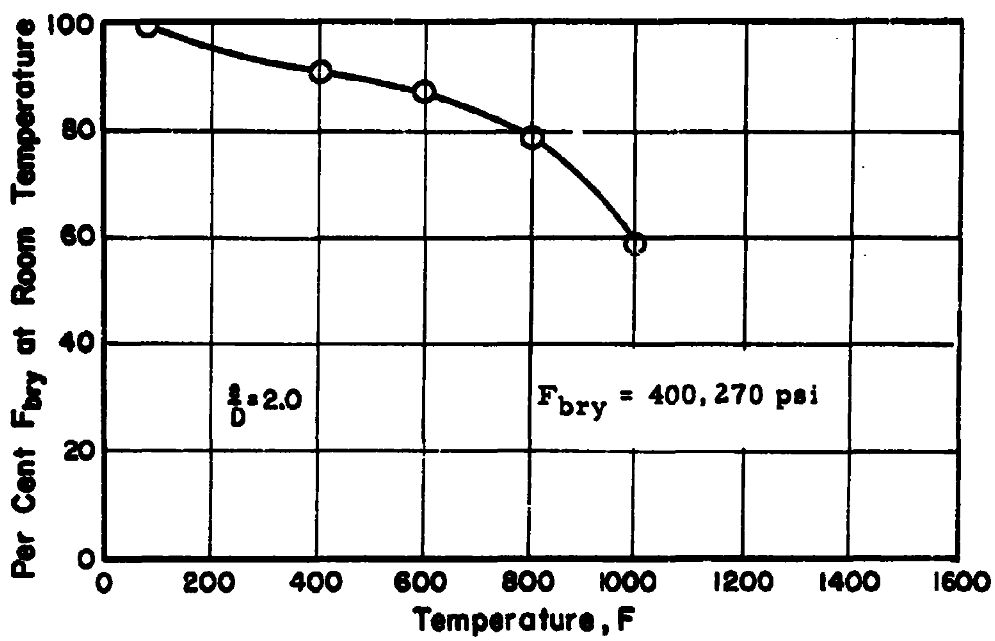


FIGURE 116. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 0.5 HOURS

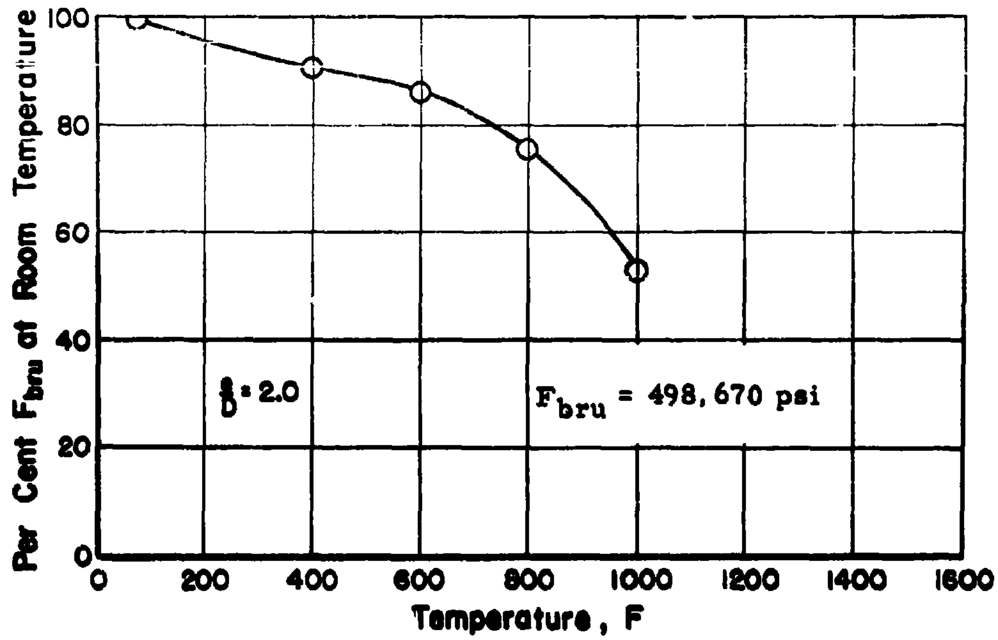


FIGURE 117. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 10 HOURS

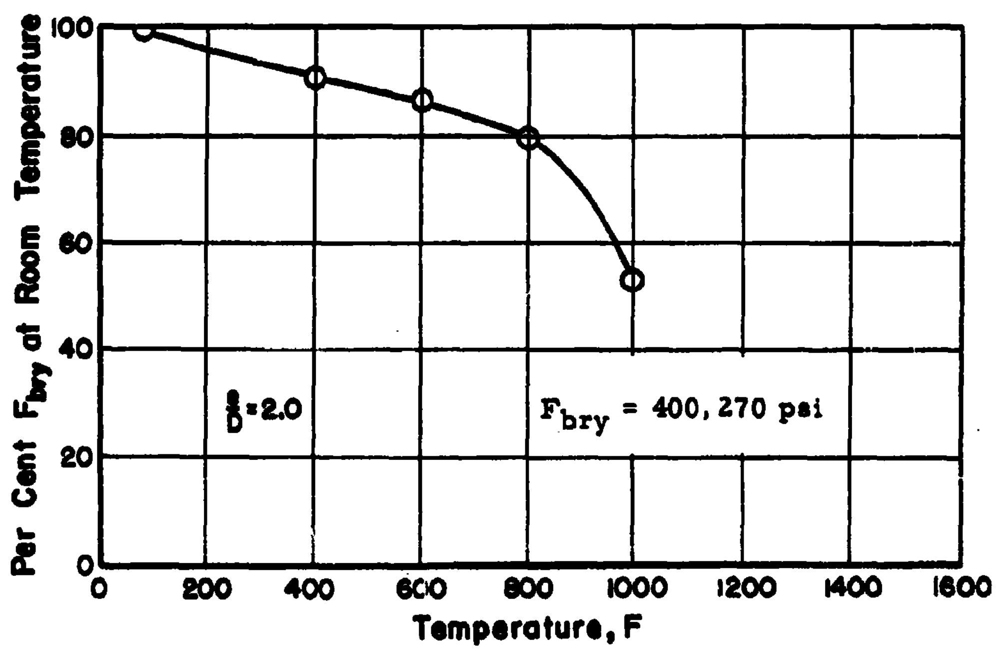


FIGURE 118. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 10 HOURS

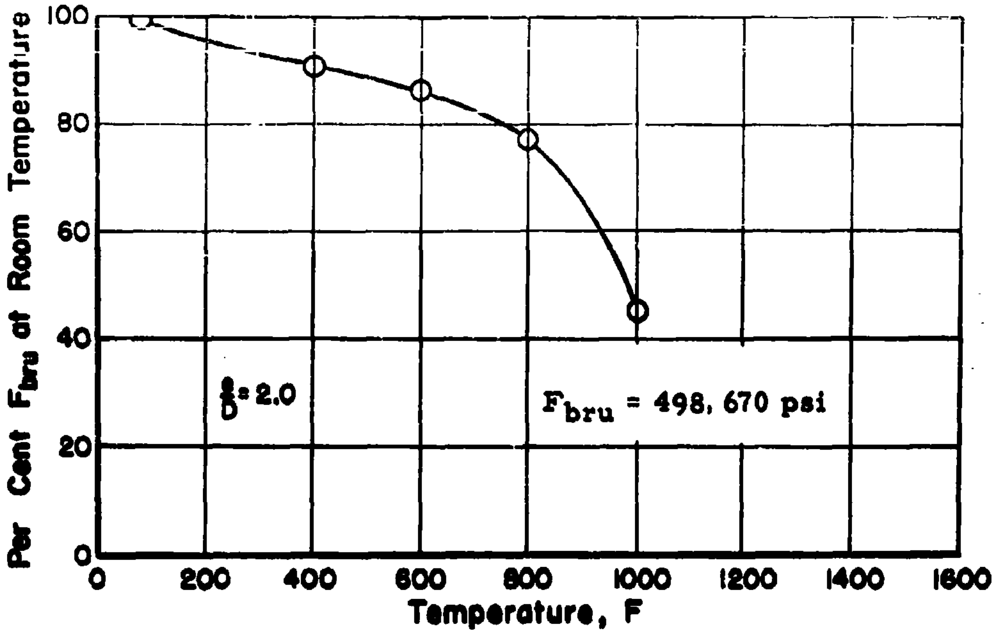


FIGURE 119. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 100 HOURS

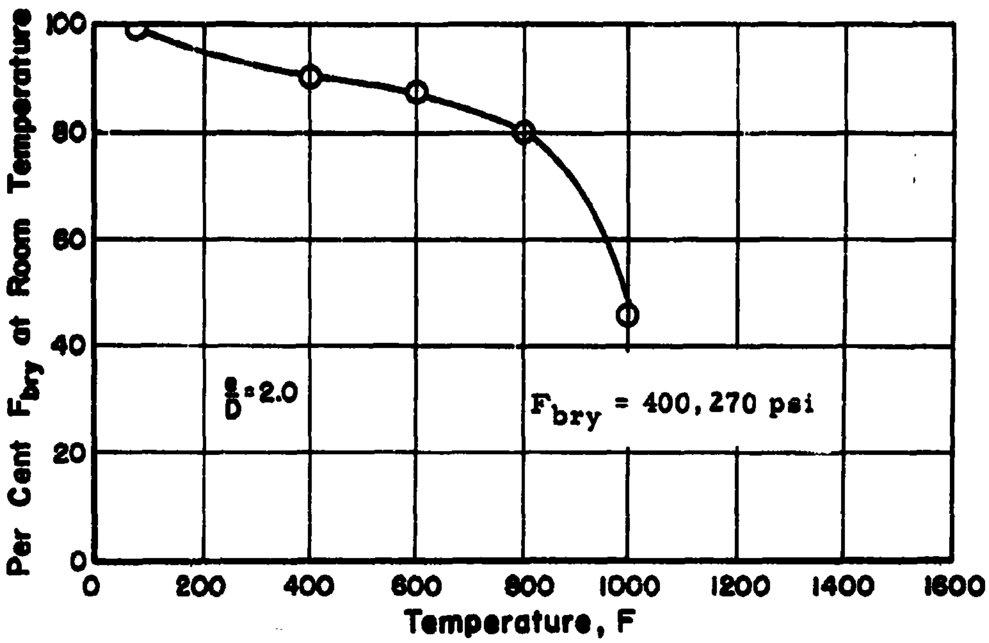


FIGURE 120. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 100 HOURS

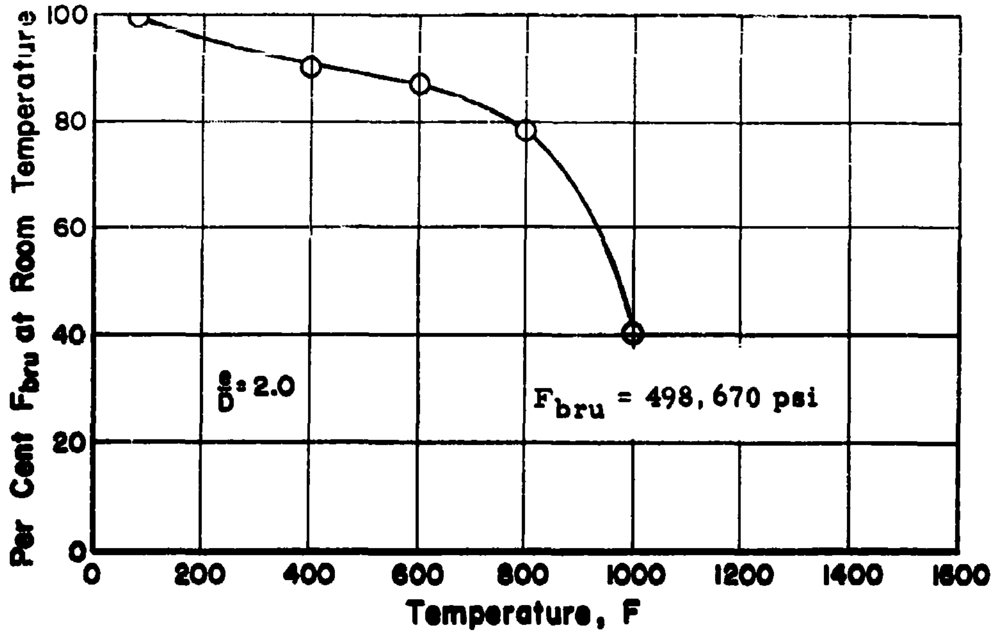


FIGURE 121. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 1000 HOURS

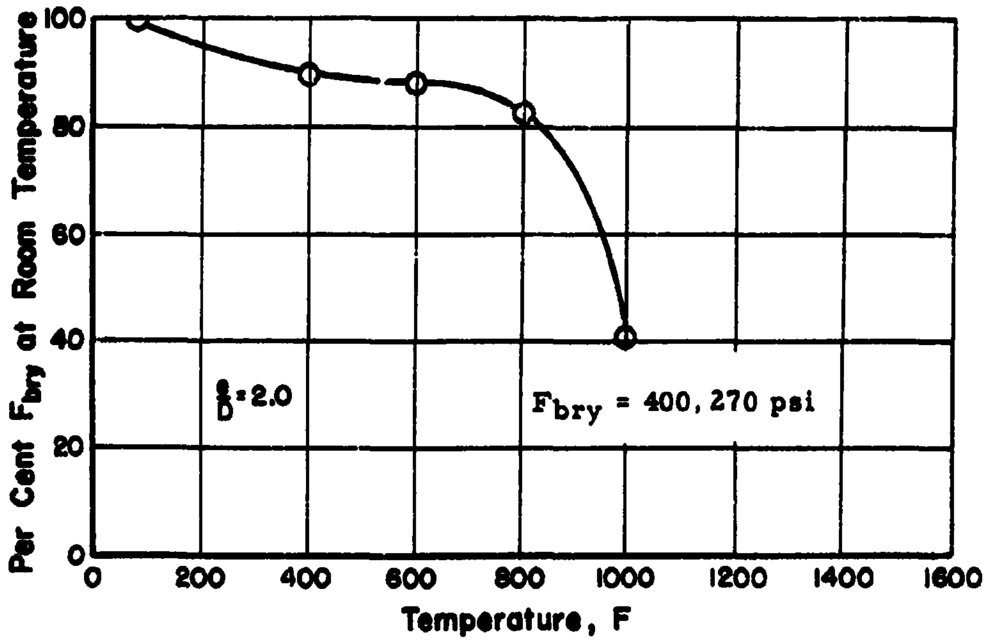


FIGURE 122. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 1000 HOURS

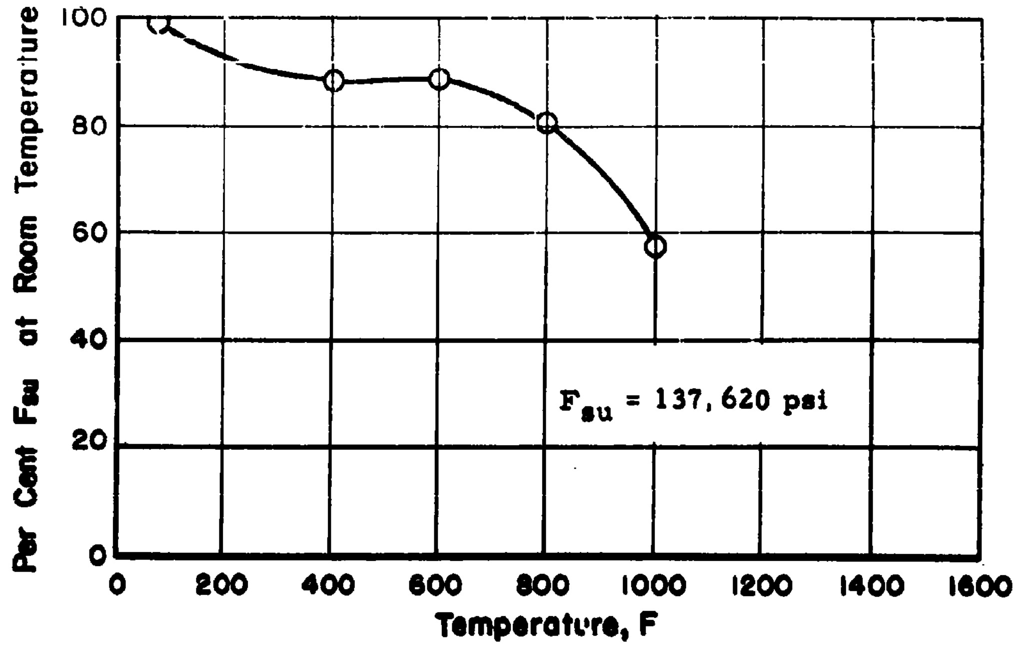


FIGURE 123. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF AM 355 EXPOSED 0.5 HOURS

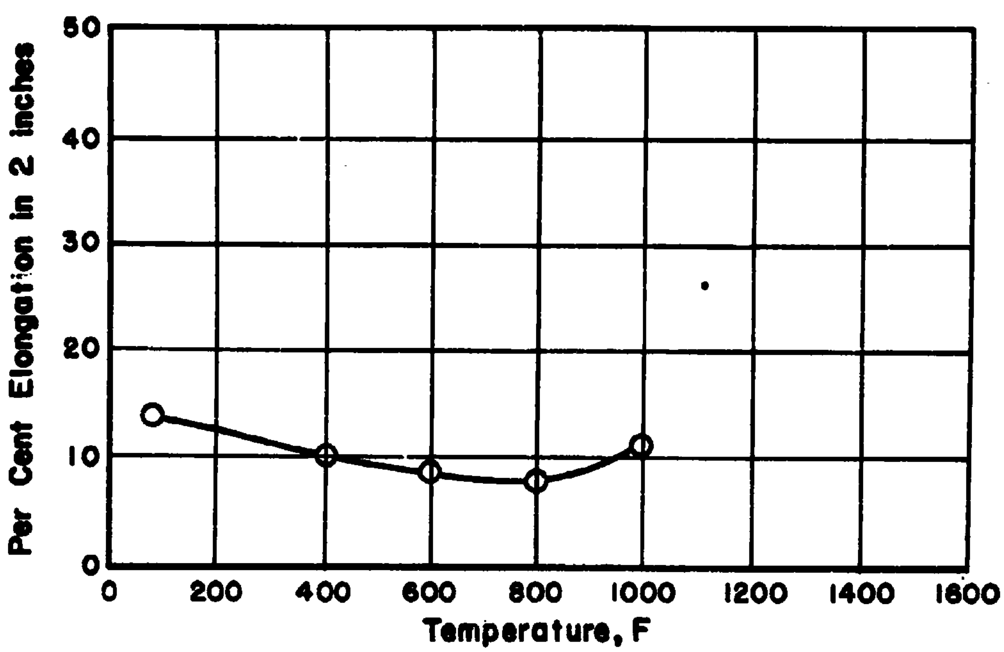


FIGURE 124. EFFECT OF TEMPERATURE ON ELONGATION OF AM 355 EXPOSED 0.5 HOURS

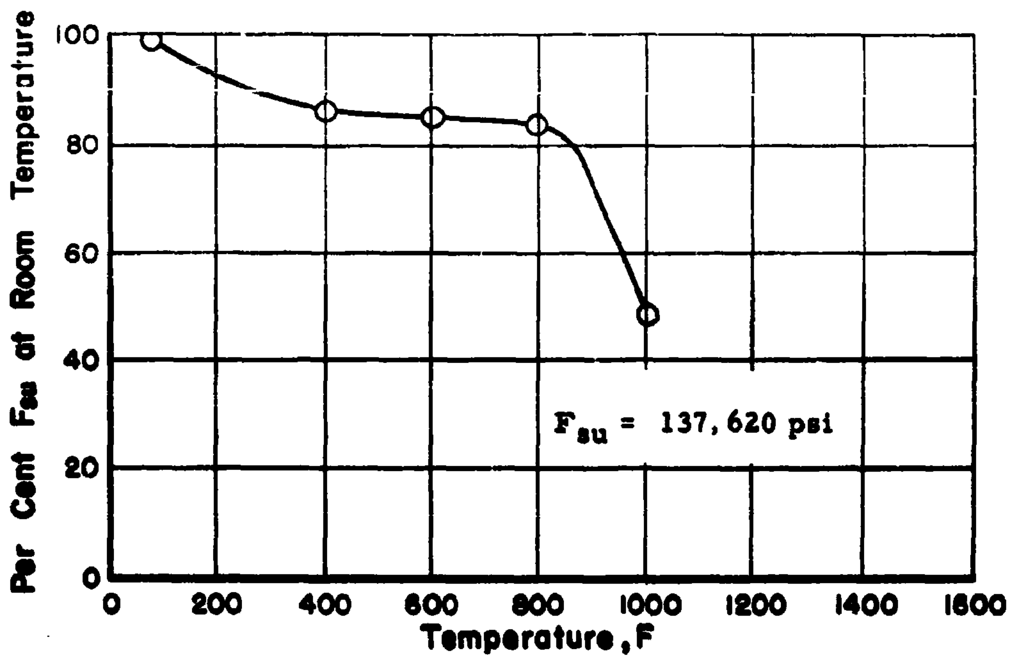


**FIGURE 125. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF AM 355 EXPOSED 10 HOURS**

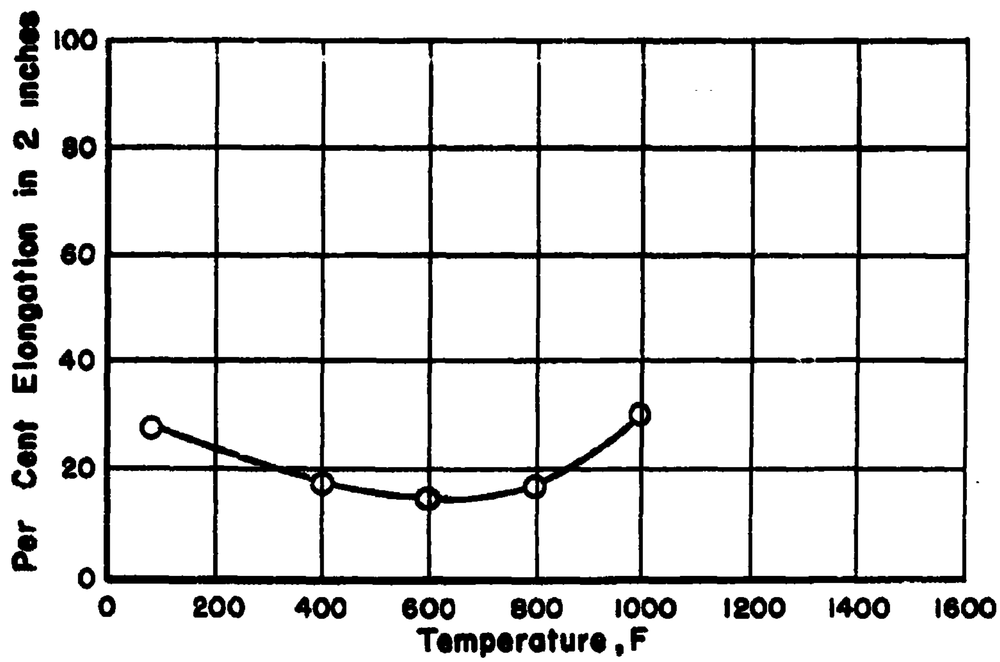


**FIGURE 126. EFFECT OF TEMPERATURE ON ELONGATION OF AM 355 EXPOSED 10 HOURS**

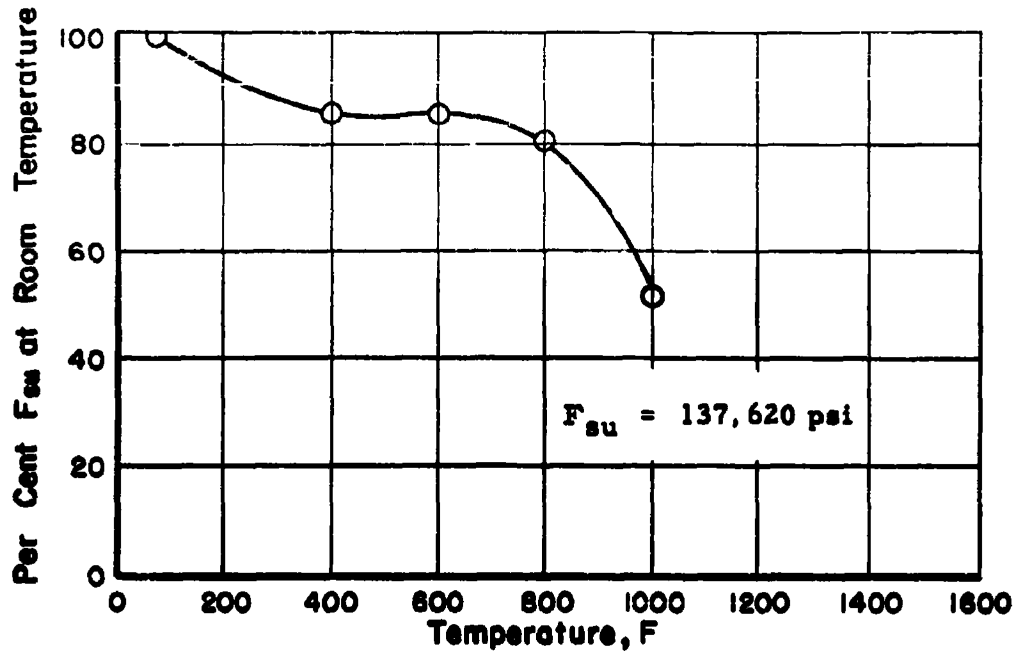


FIGURE 127. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF AM 355 EXPOSED 100 HOURS

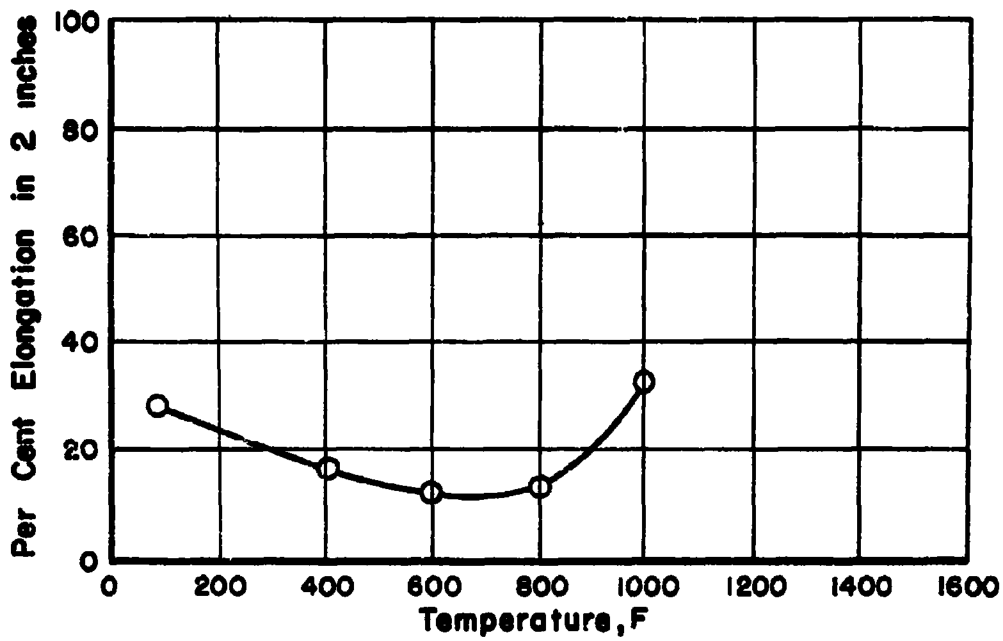


FIGURE 128. EFFECT OF TEMPERATURE ON ELONGATION OF AM 355 EXPOSED 100 HOURS

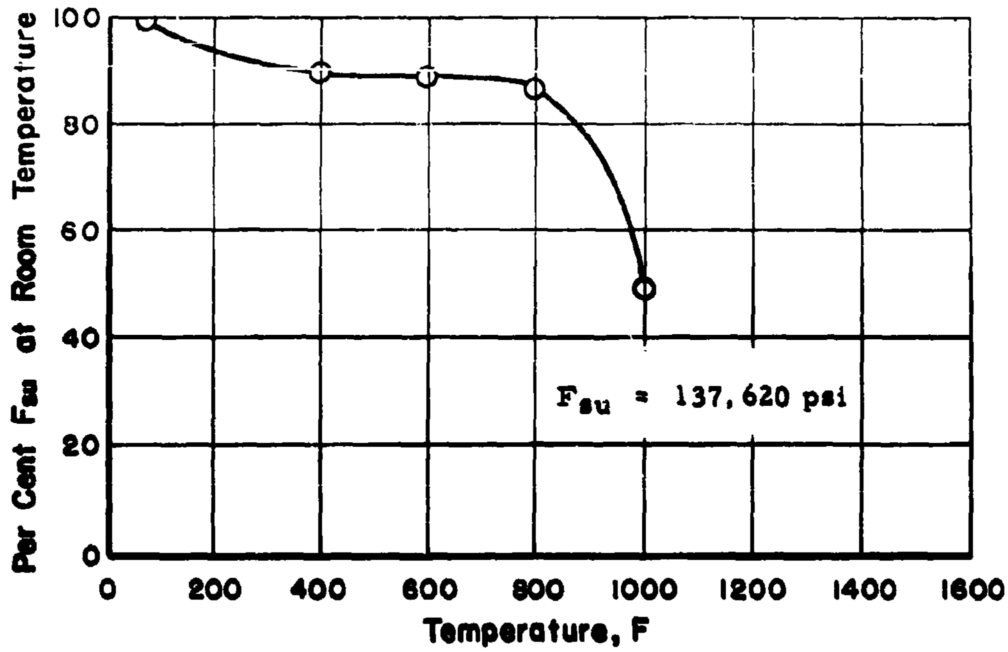


FIGURE 129. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF AM 355 EXPOSED 1000 HOURS

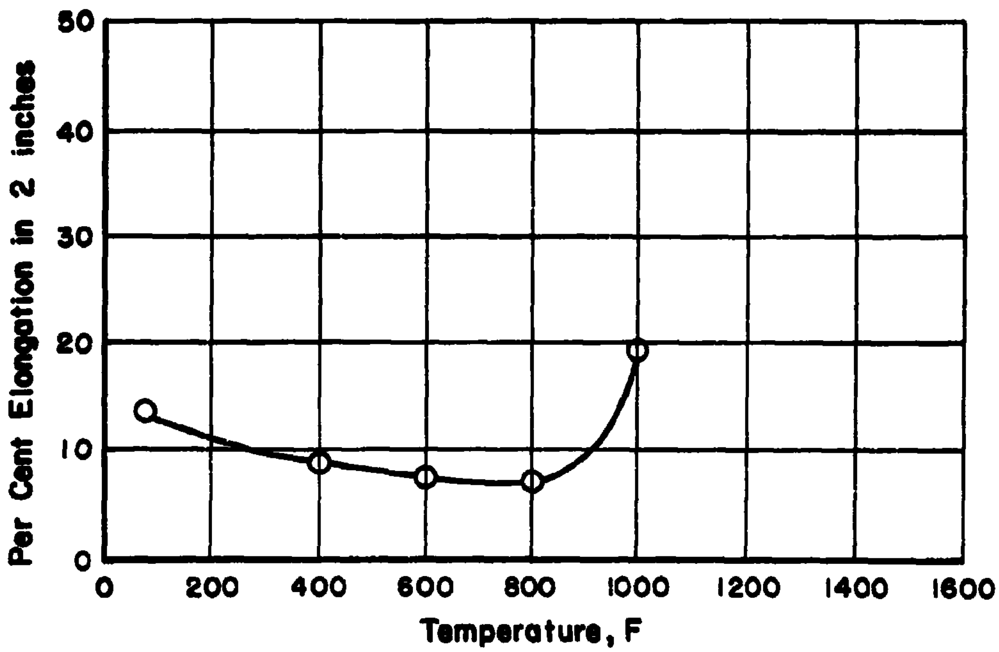


FIGURE 130. EFFECT OF TEMPERATURE ON ELONGATION OF AM 355 EXPOSED 1000 HOURS

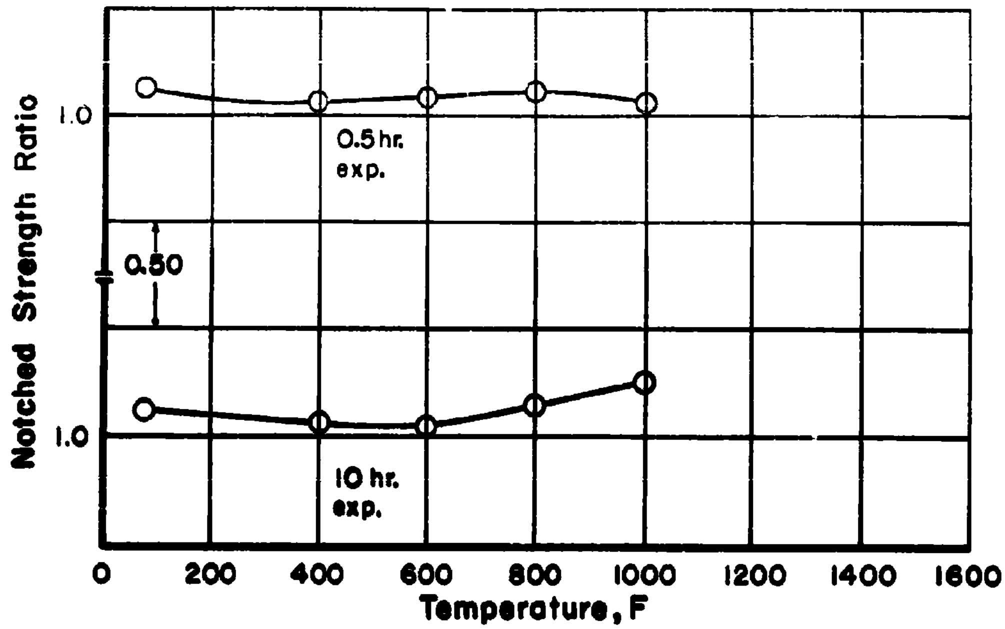


FIGURE 131. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF AM 355 EXPOSED 0.5 AND 10 HOURS

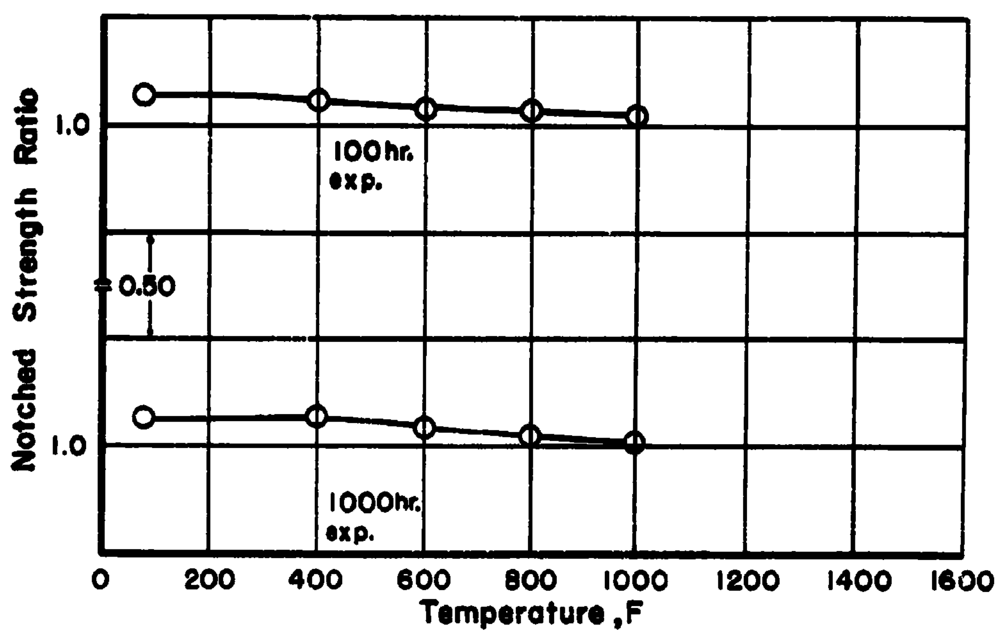


FIGURE 132. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF AM 355 EXPOSED 100 AND 1000 HOURS

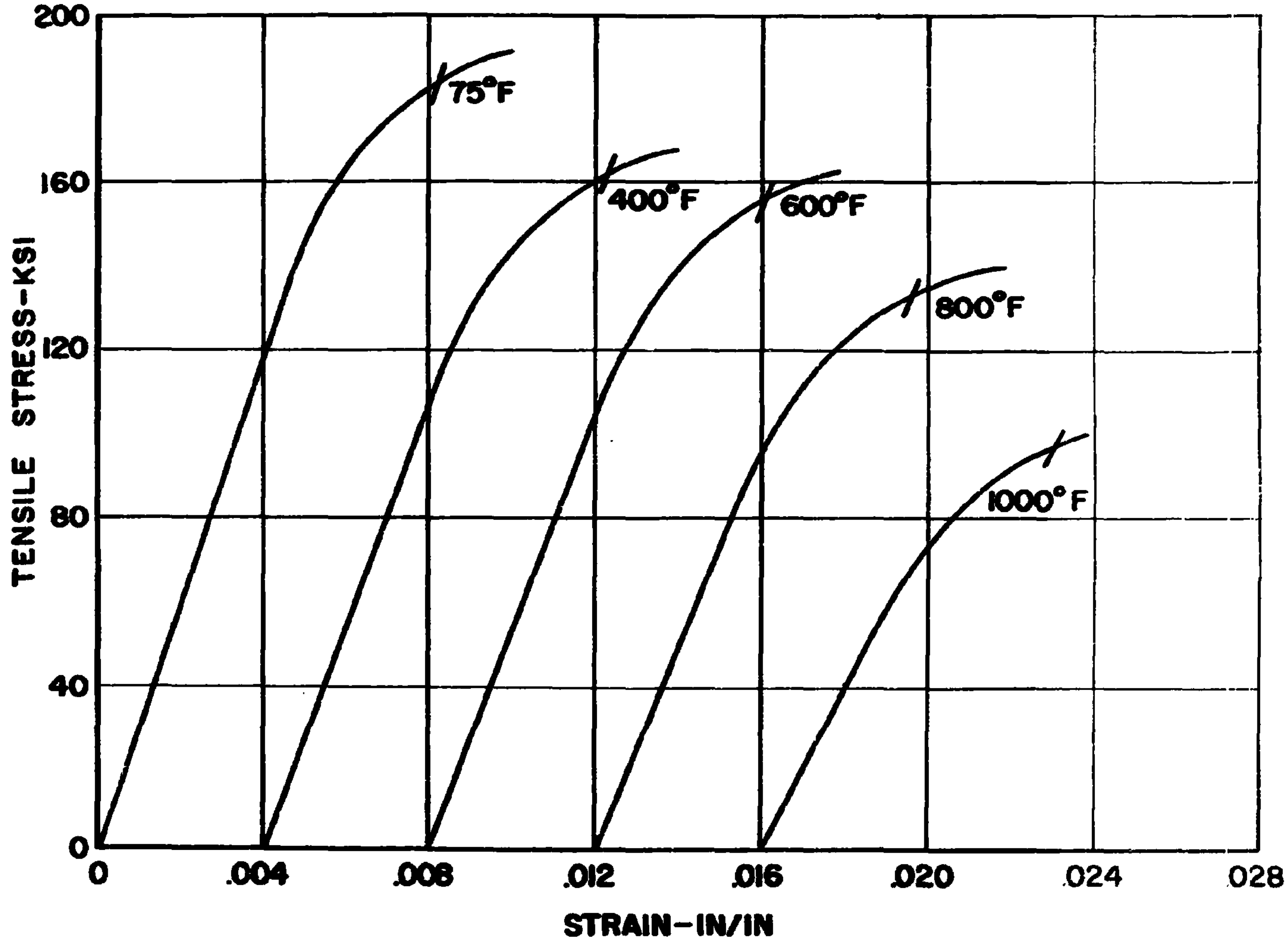


FIGURE 133. TENSILE STRESS-STRAIN CURVES OF AM 355
EXPOSED 0. 5 HOURS

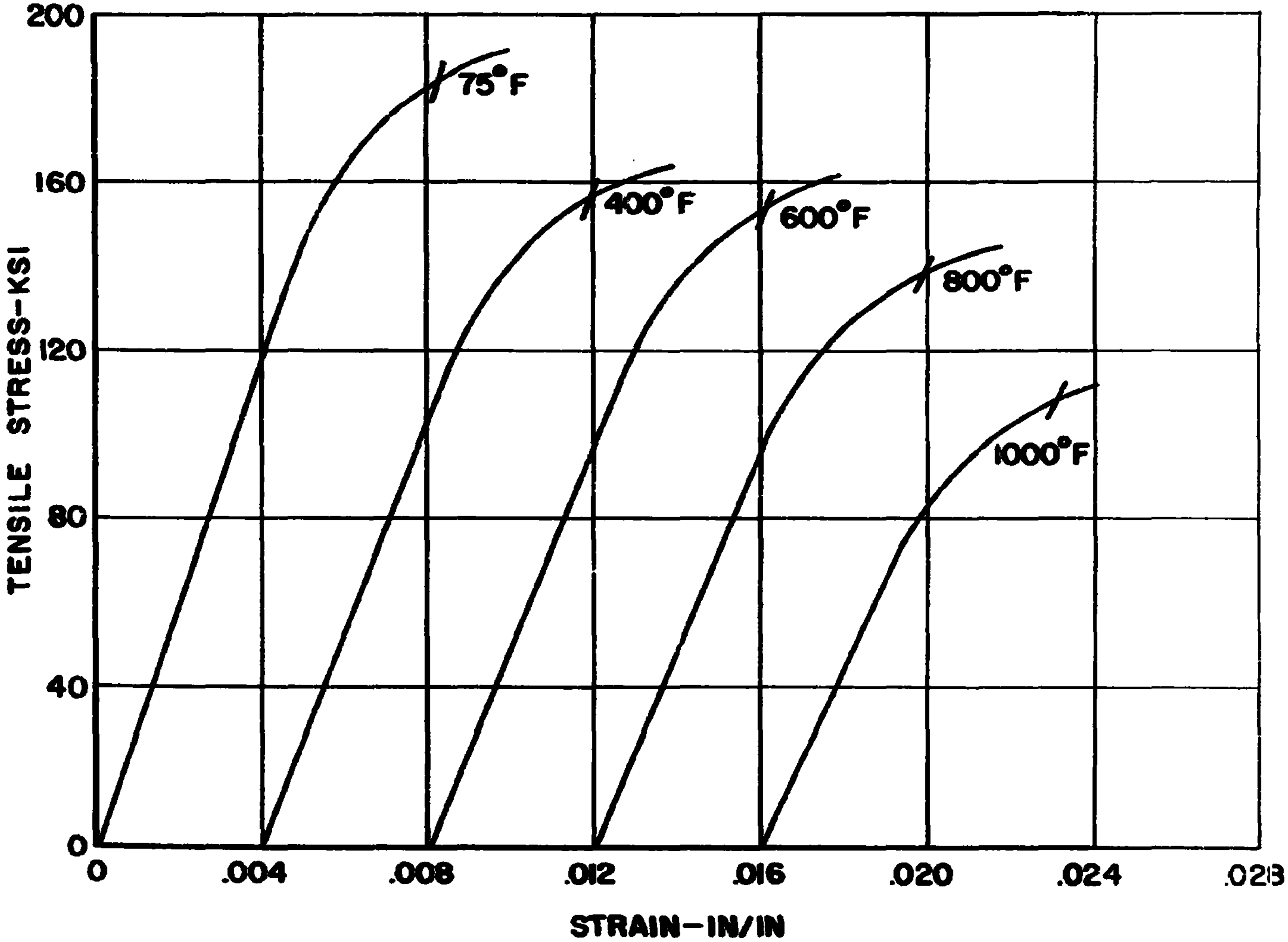


FIGURE 134. TENSILE STRESS-STRAIN CURVES OF AM 355 EXPOSED 10 HOURS

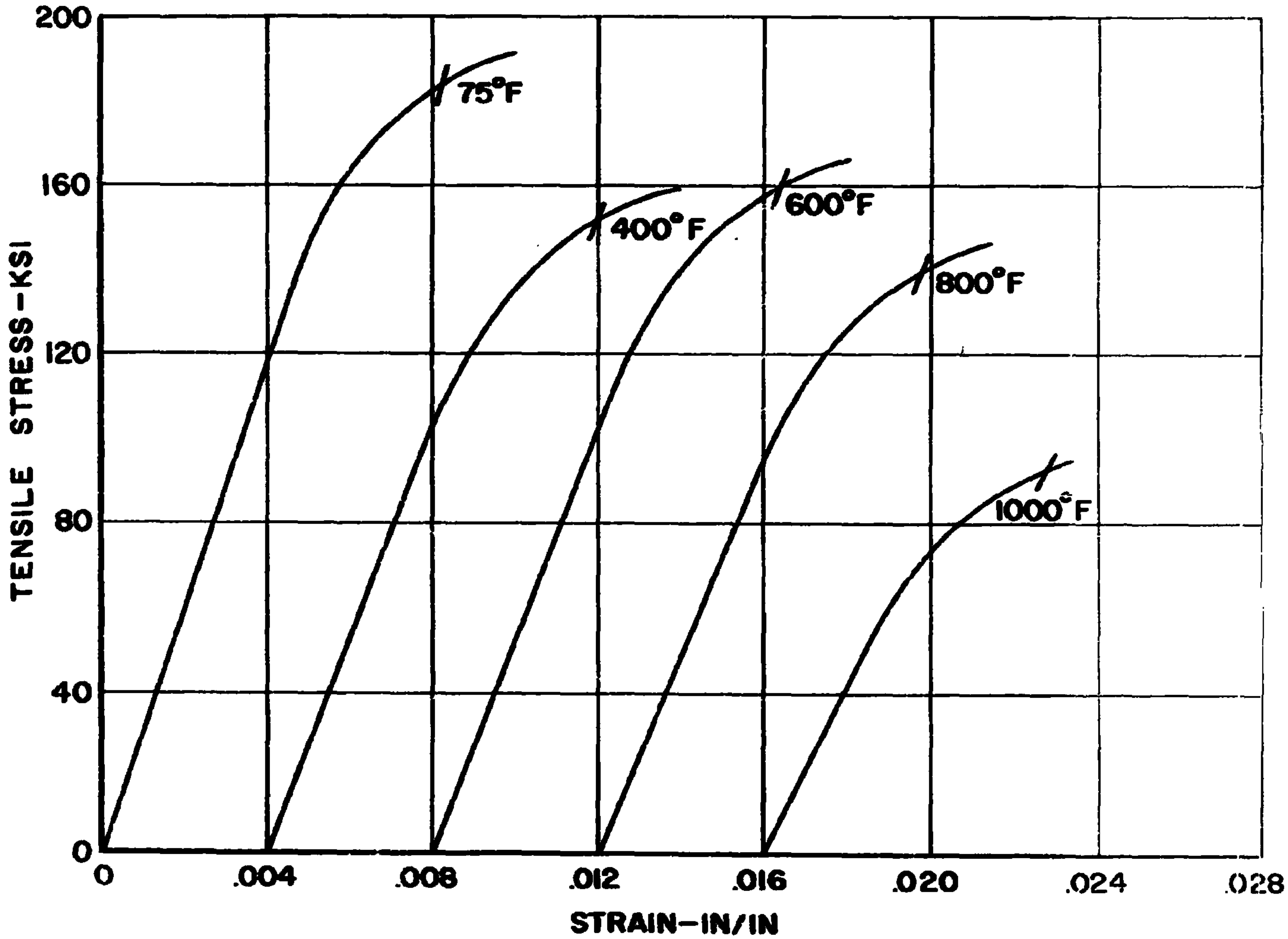


FIGURE 135. TENSILE STRESS-STRAIN CURVES OF AM 355 EXPOSED 100 HOURS

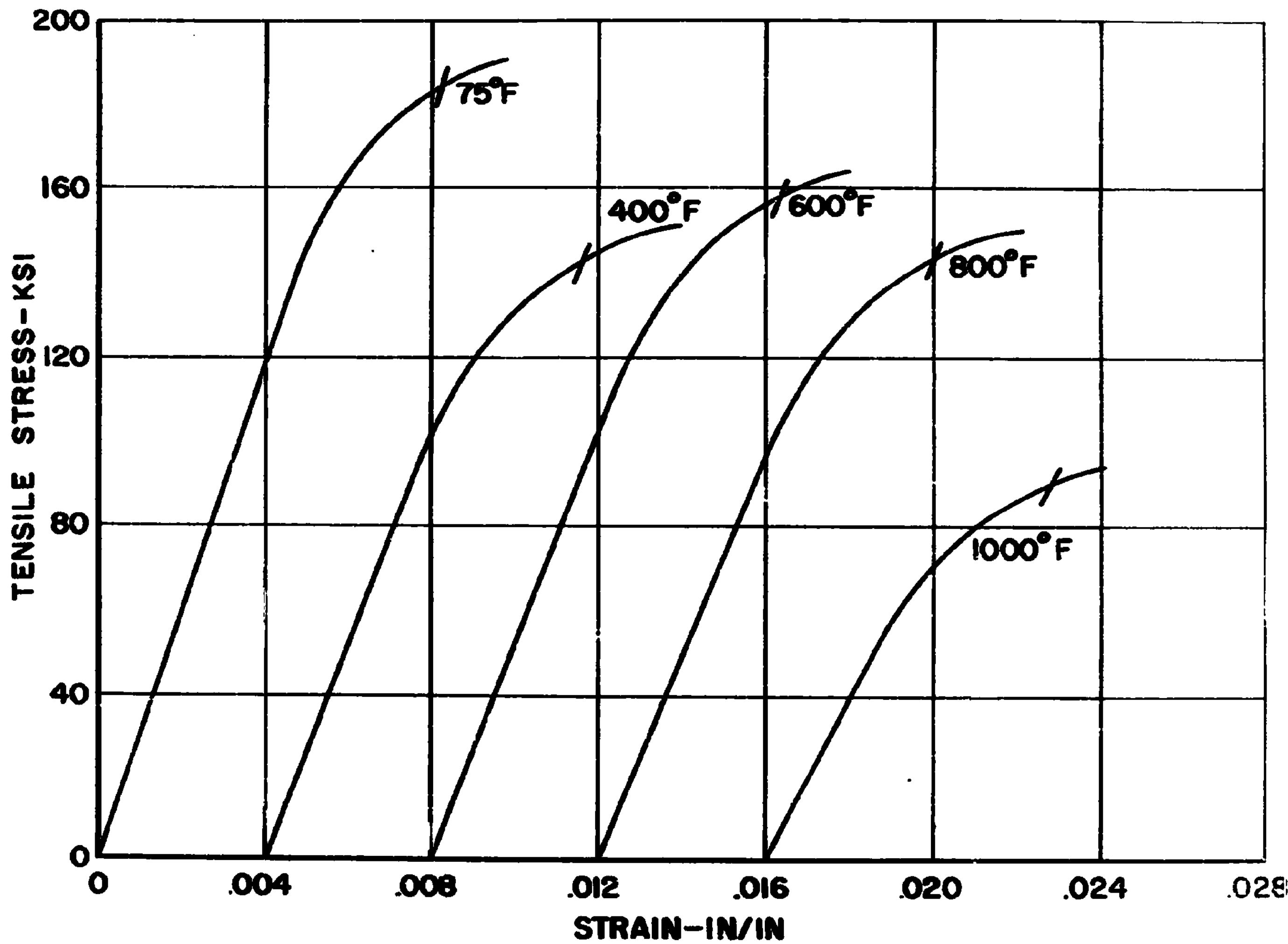


FIGURE 136. TENSILE STRESS-STRAIN CURVES OF AM 355 EXPOSED 1000 HOURS

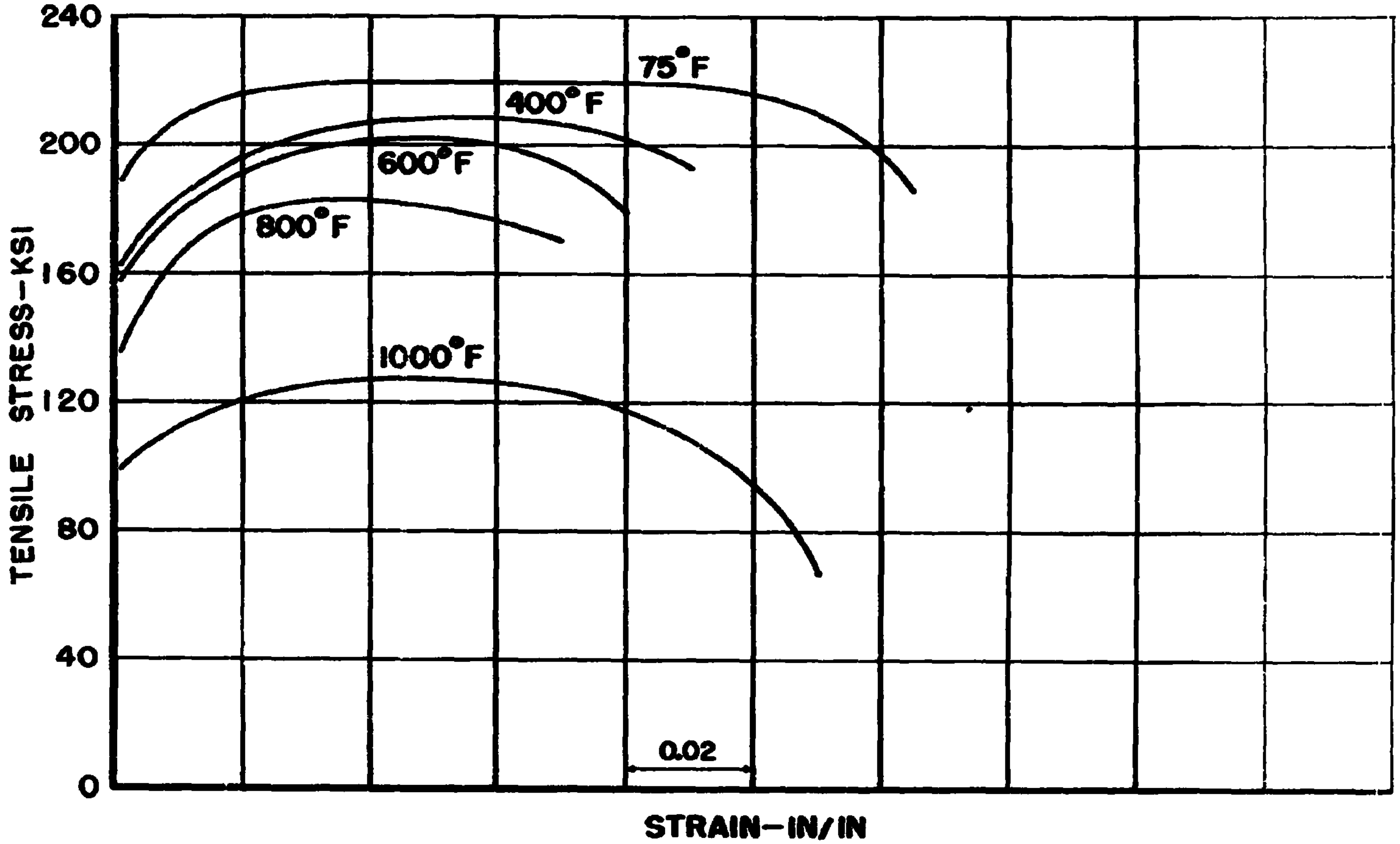


FIGURE 137. TENSILE POSTYIELD STRESS-STRAIN CURVES OF AM 355 EXPOSED 0.5 HOURS

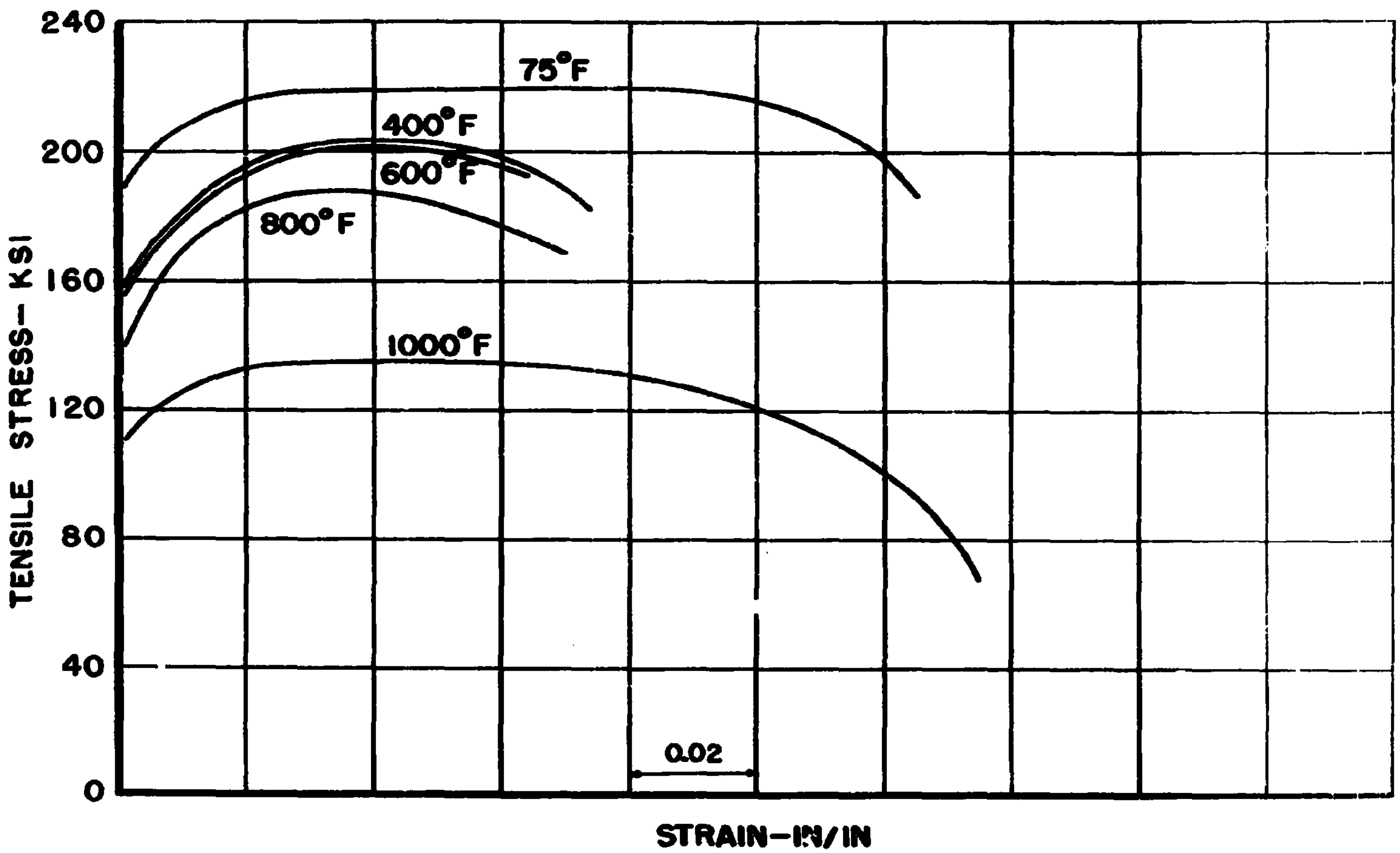


FIGURE 138. TENSILE POSTYIELD STRESS-STRAIN CURVES OF AM 355 EXPOSED 10 HOURS

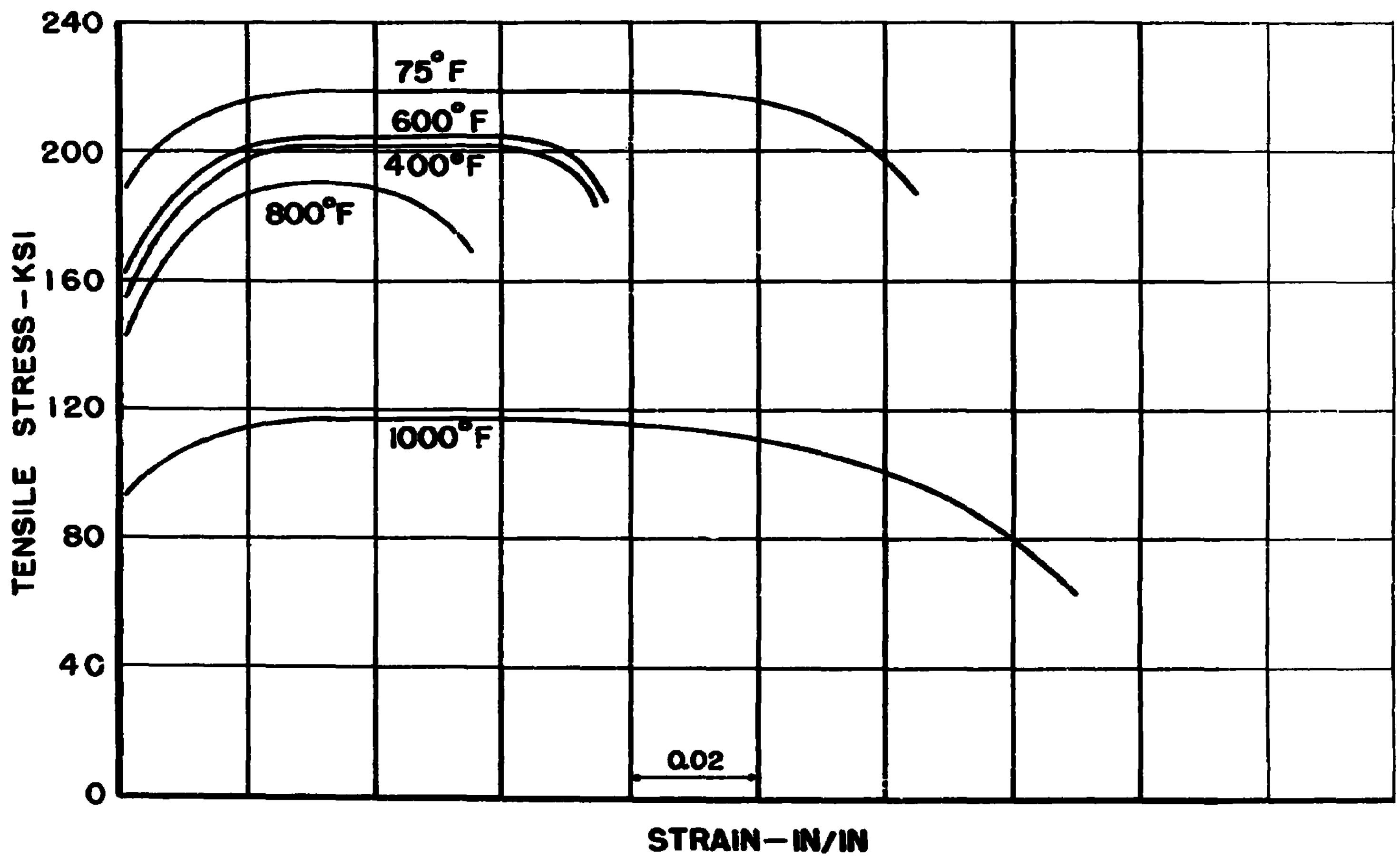


FIGURE 139. TENSILE POSTYIELD STRESS-STRAIN CURVES OF AM 355 EXPOSED 100 HOURS

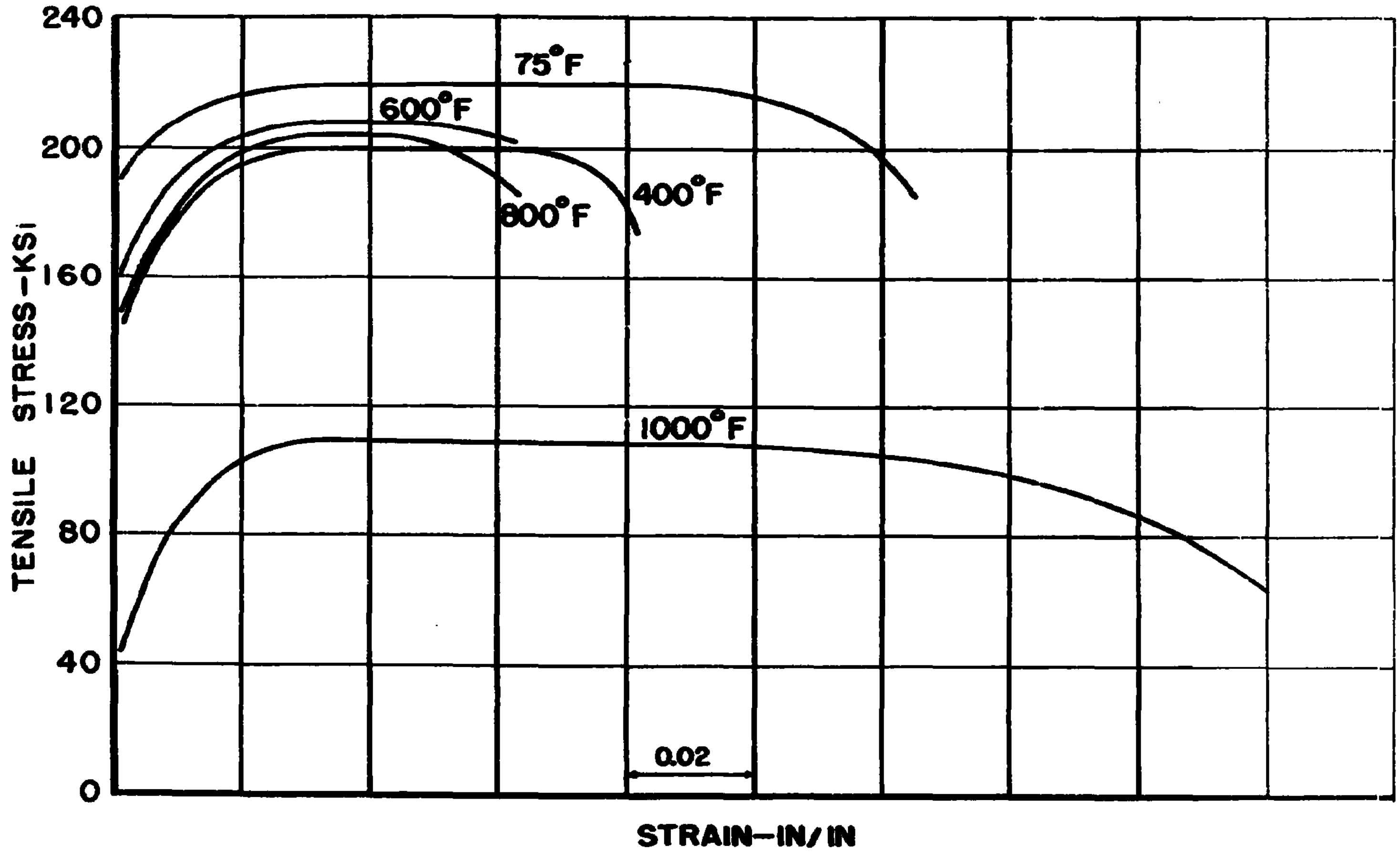


FIGURE 140. TENSILE POSTYIELD STRESS-STRAIN CURVES OF AM 355 EXPOSED 1000 HOURS

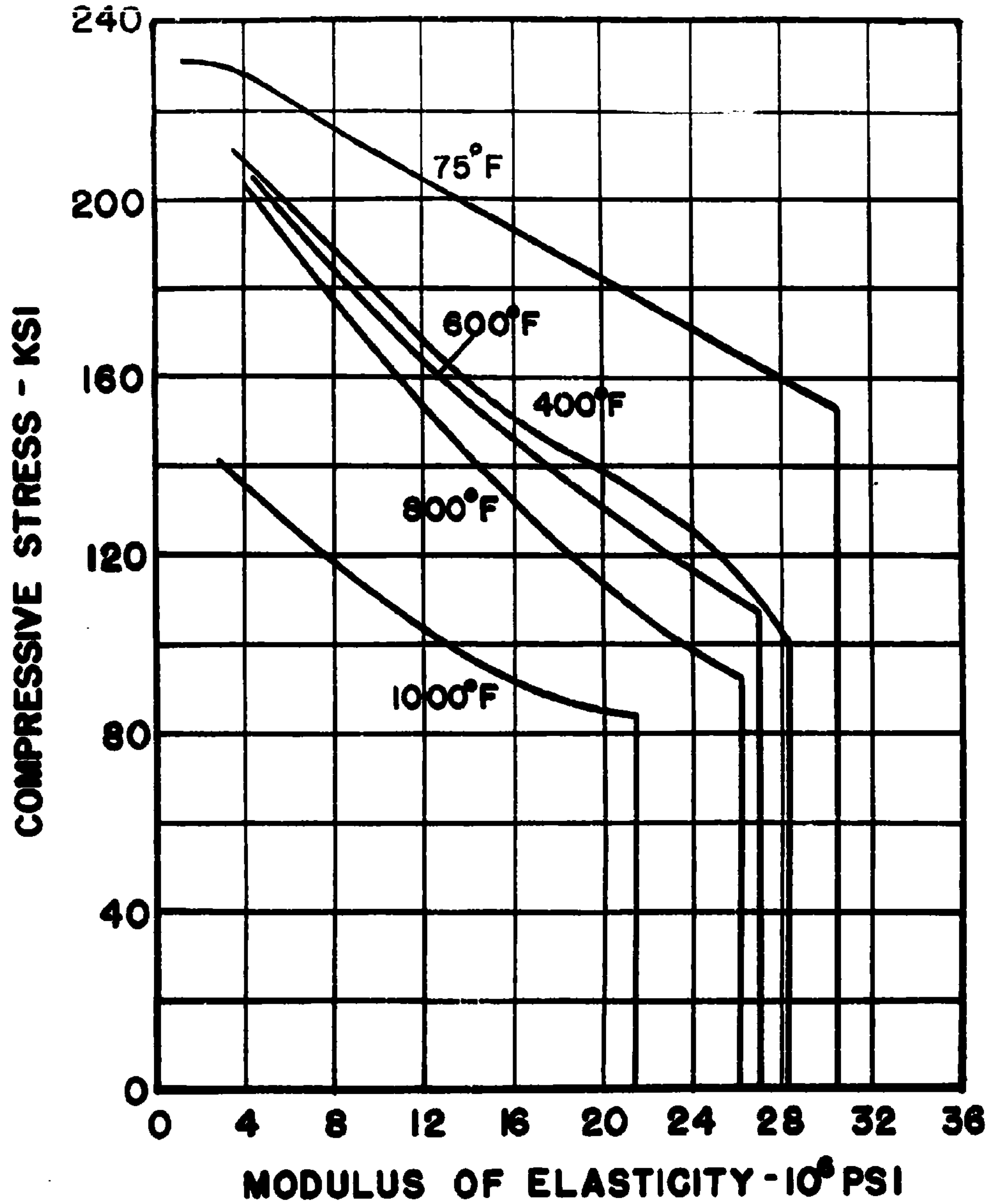


FIGURE 141. COMPRESSIVE TANGENT MODULUS CURVES OF AM 355 EXPOSED 0.5 HOURS

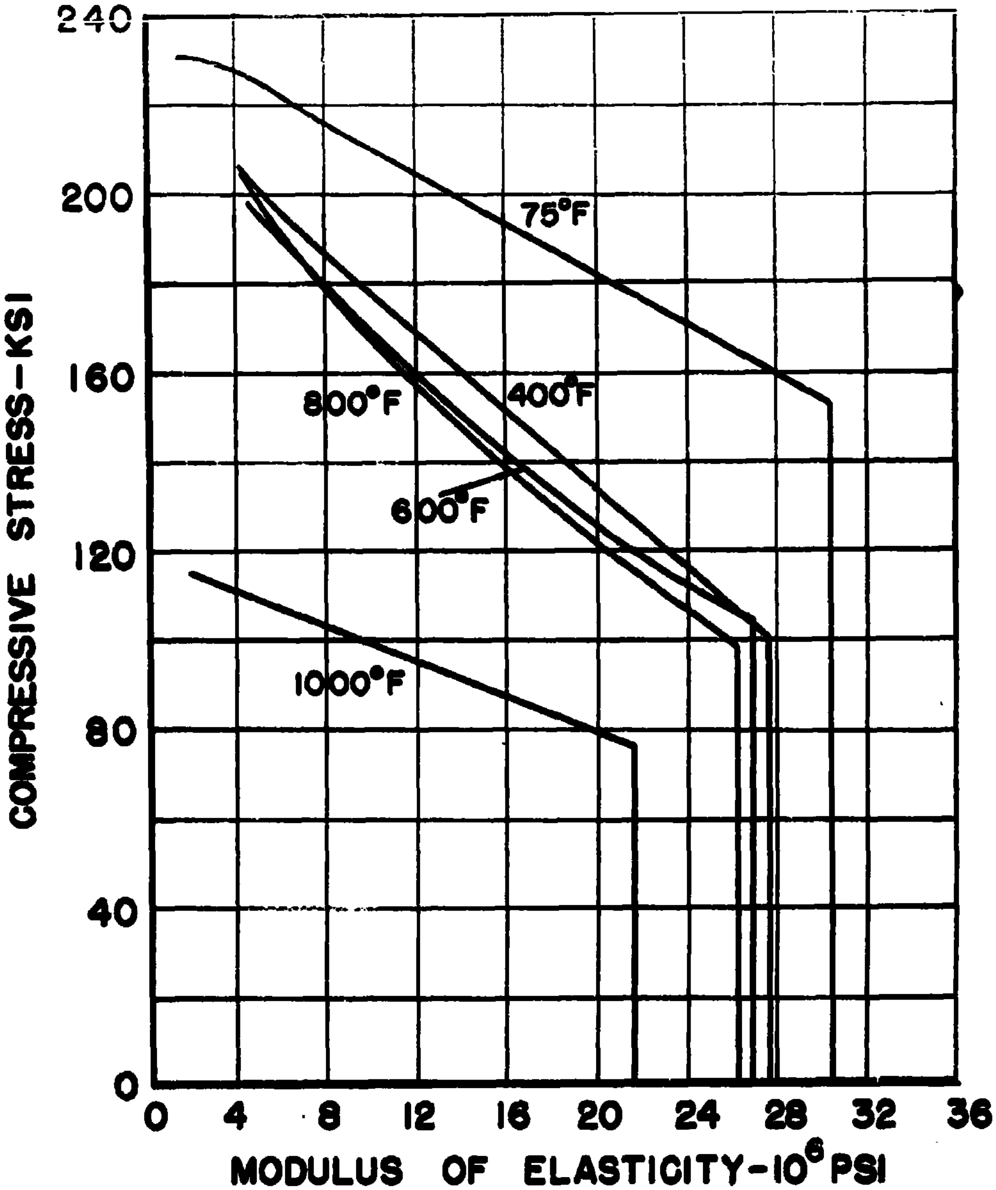


FIGURE 142. COMPRESSIVE TANGENT MODULUS CURVES OF AM 355 EXPOSED 10 HOURS

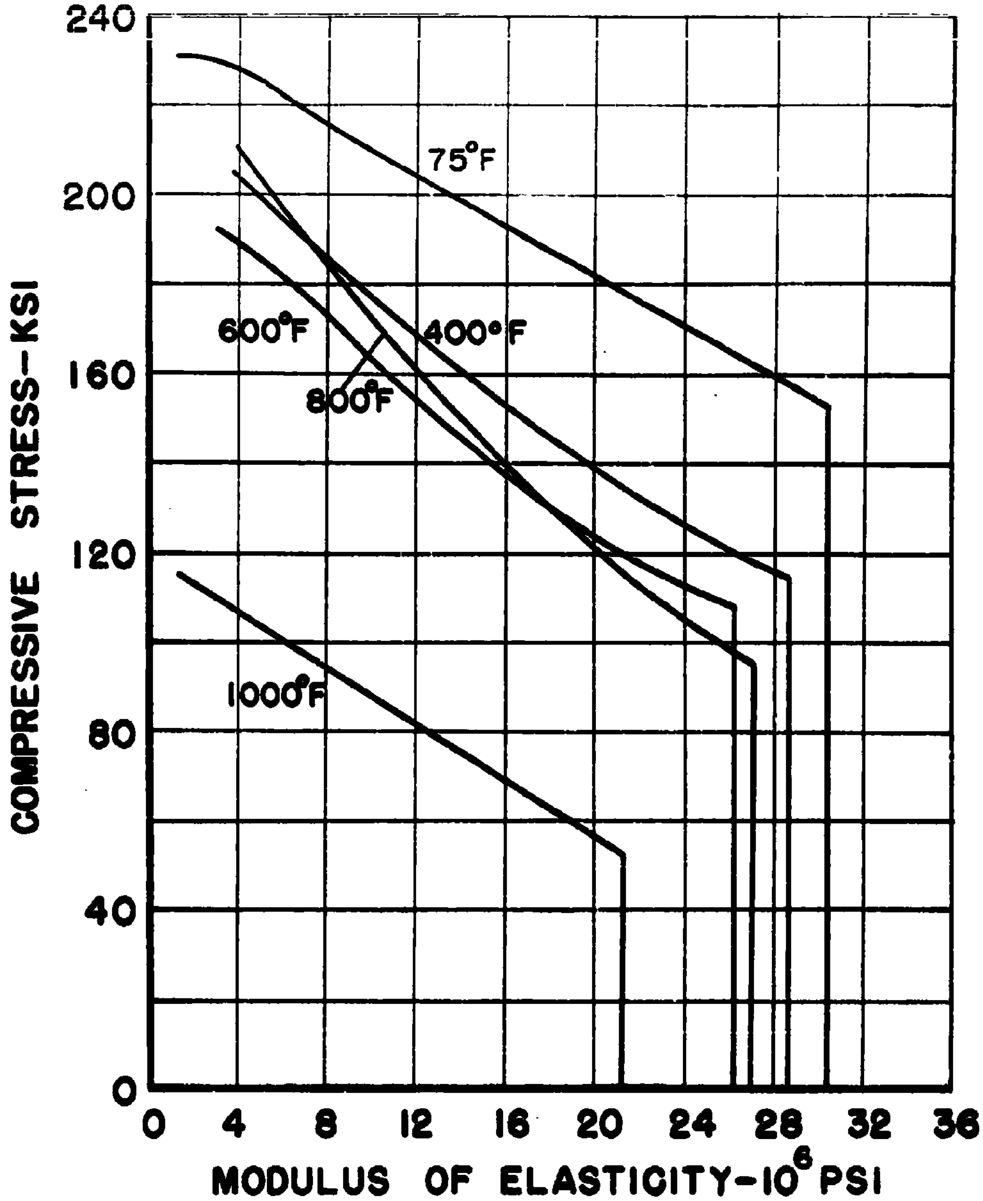


FIGURE 143. COMPRESSIVE TANGENT MODULUS CURVES OF AM 355 EXPOSED 100 HOURS

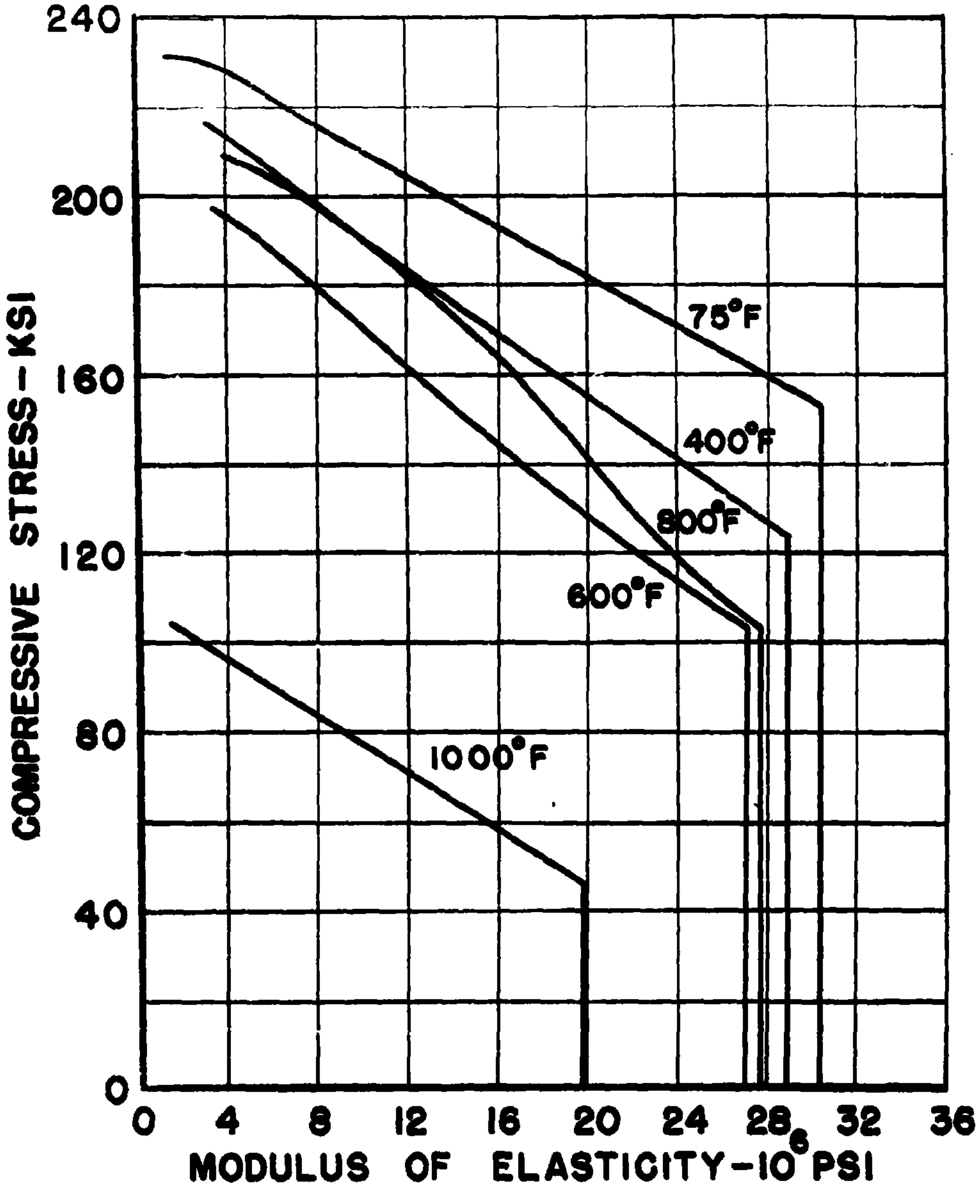


FIGURE 144. COMPRESSIVE TANGENT MODULUS CURVES OF AM 355 EXPOSED 1000 HOURS

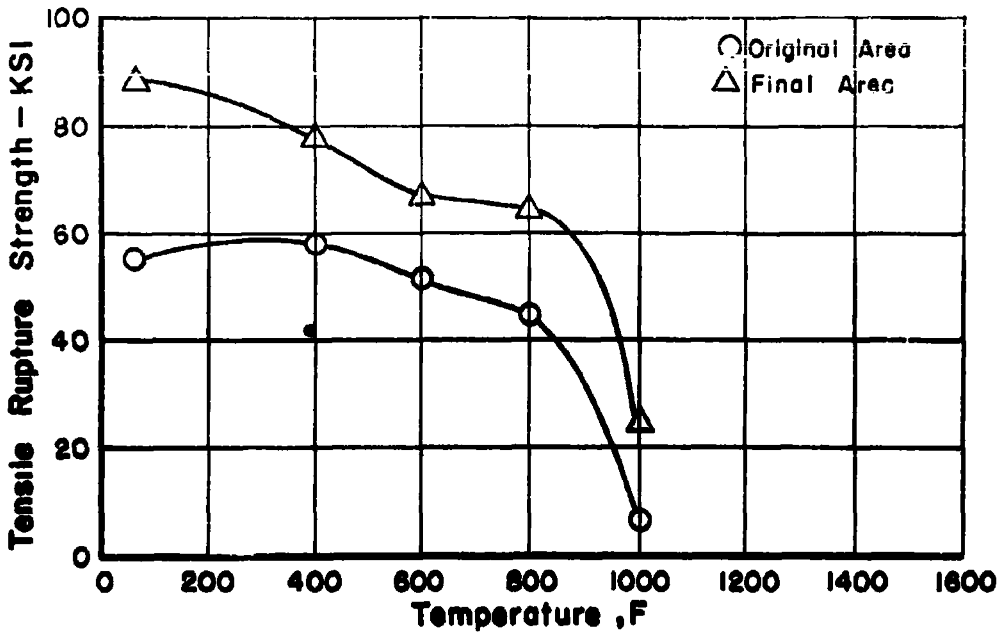


FIGURE 145. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF AM 355 EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

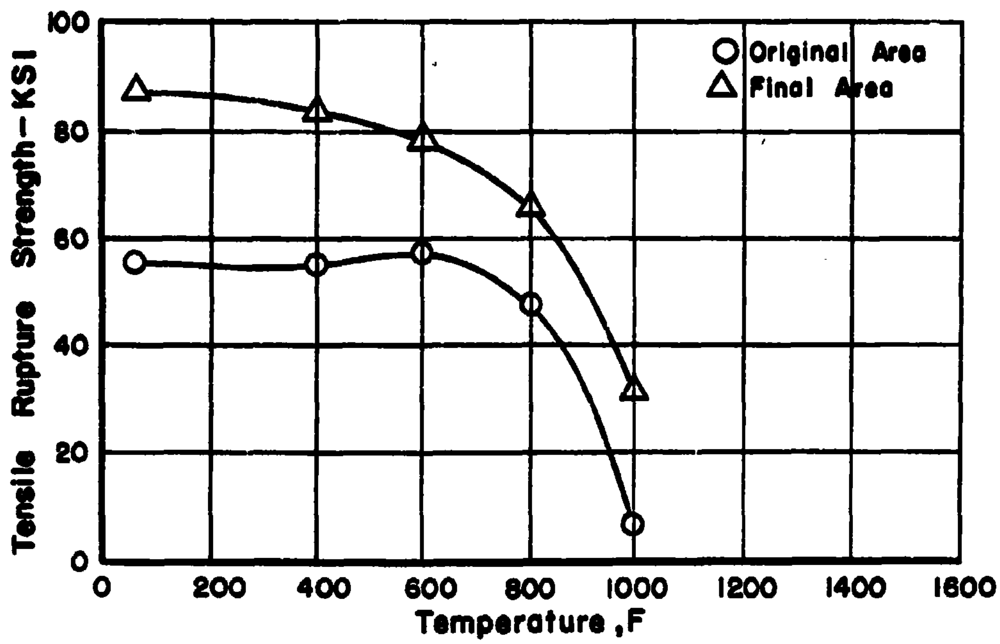


FIGURE 146. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF AM 355 EXPOSED 10 HOURS, BASED ON ORIGINAL AND FINAL AREAS

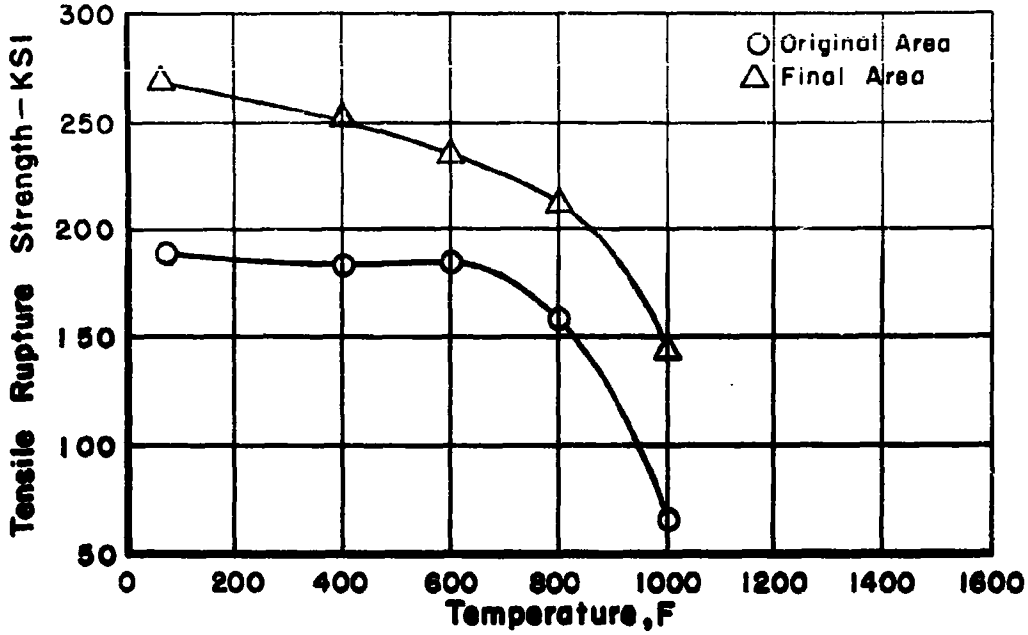


FIGURE 147. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF AM 355 EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

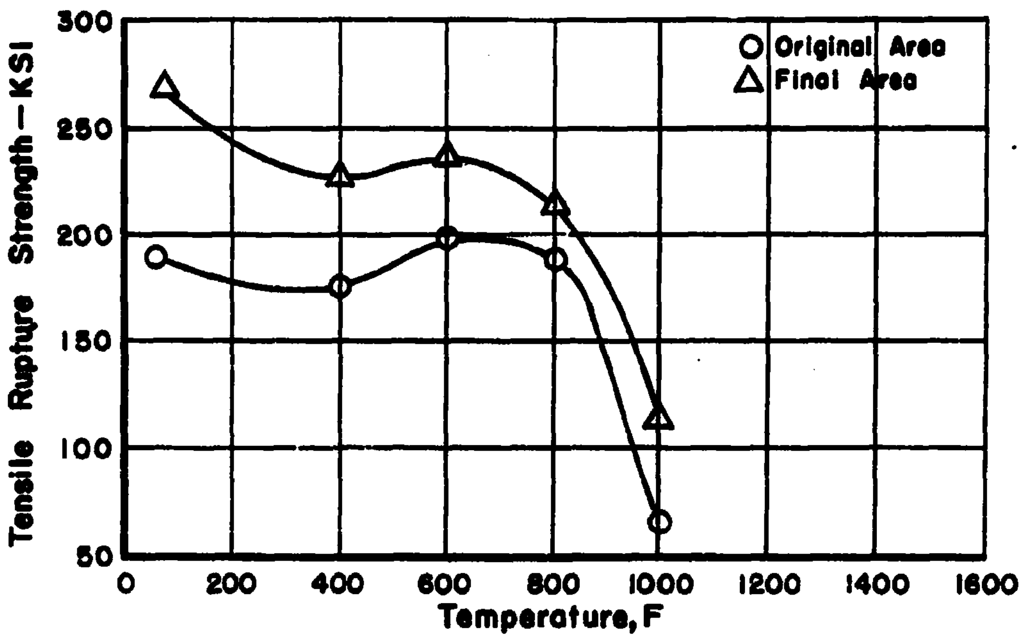


FIGURE 148. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF AM 355 EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

## APPENDIX III

## SUMMARY OF ROOM TEMPERATURE PROPERTIES OF RENÉ 41

**Form: 0.051 Inch Sheet**

**Condition: C**

**Properties:**

| | | | | |
|---|---|---|---|---|
| Ultimate Tensile Strength | - | $F_{tu}$ | = | 184,850 psi |
| Tensile Yield Strength | - | $F_{ty}$ | = | 141,790 psi |
| Modulus of Elasticity | - | $E$ | = | $29.97 \times 10^6$ psi |
| Percent Elongation in 2 inches | | | = | 10.4 |
| Notched Tensile Strength | - | $F_{tu}$ | = | 190,290 psi |
| Compressive Yield Strength | - | $F_{cy}$ | = | 147,070 psi |
| Compressive Modulus of Elasticity | - | $E_c$ | = | $31.63 \times 10^6$ psi |
| Ultimate Bearing Strength | | | | |
| (e/D = 1.5) | - | $F_{bru}$ | = | 297,660 psi |
| (e/D = 2.0) | - | $F_{bru}$ | = | 369,760 psi |
| Bearing Yield Strength | | | | |
| (e/D = 1.5) | - | $F_{bry}$ | = | 236,200 psi |
| (e/D = 2.0) | - | $F_{bry}$ | = | 290,360 psi |
| Ultimate Shear Strength | - | $F_{su}$ | = | 115,180 psi |

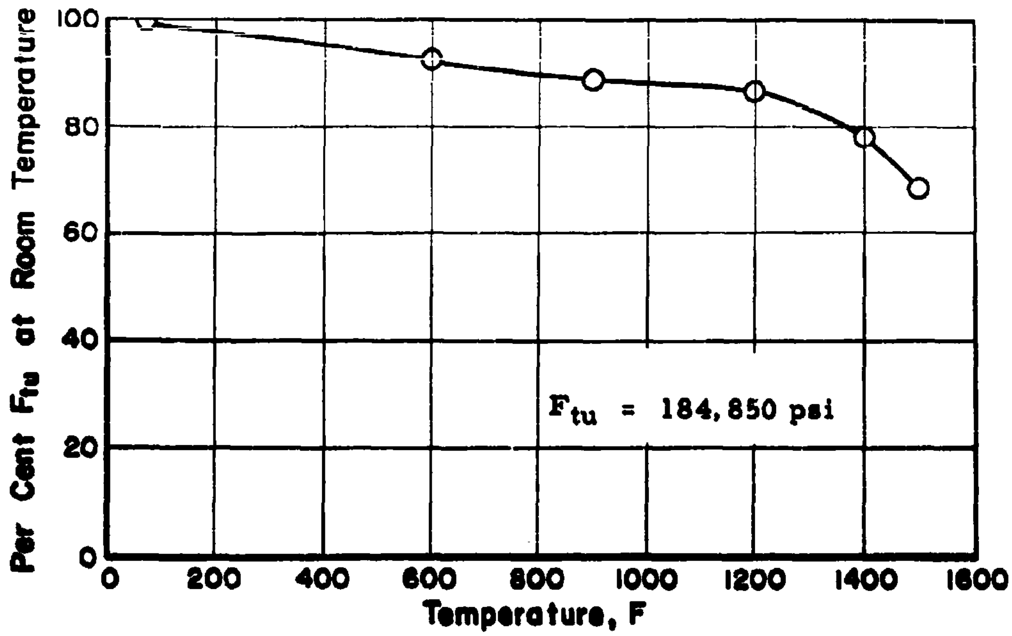


FIGURE 149. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 0 5 HOURS

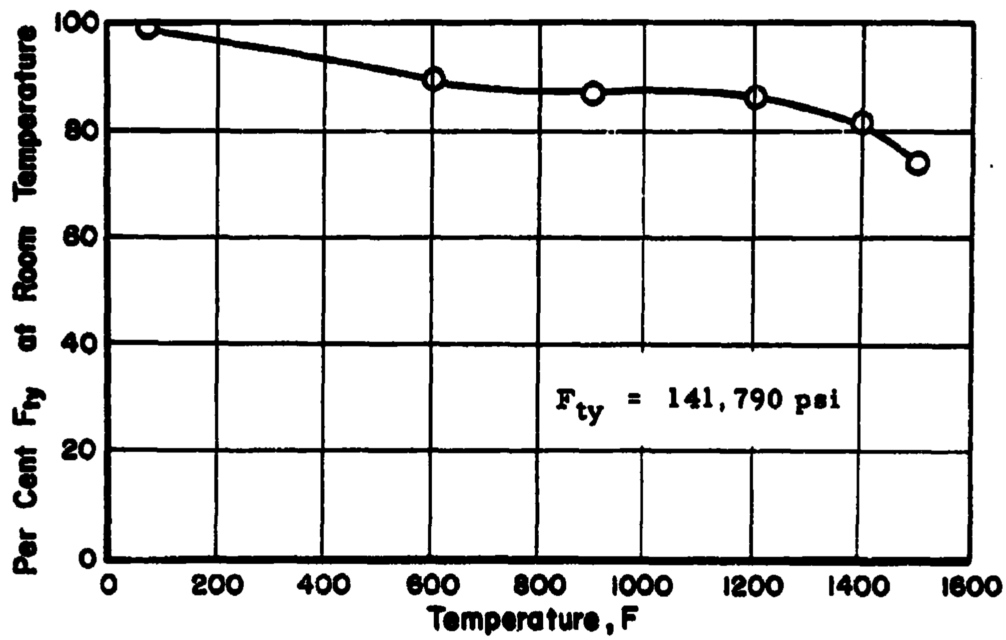


FIGURE 150. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

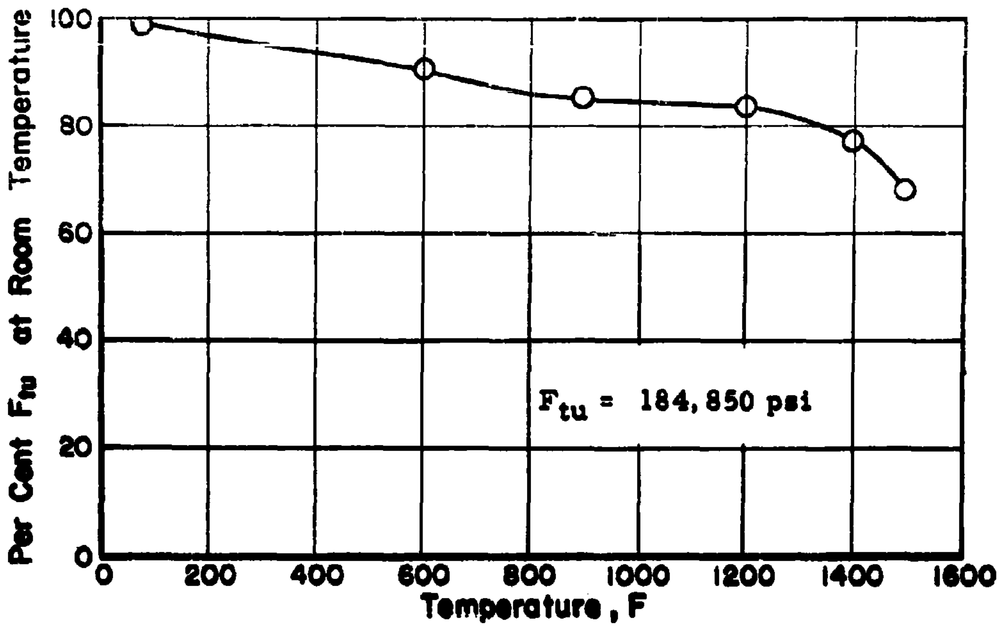


FIGURE 151. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

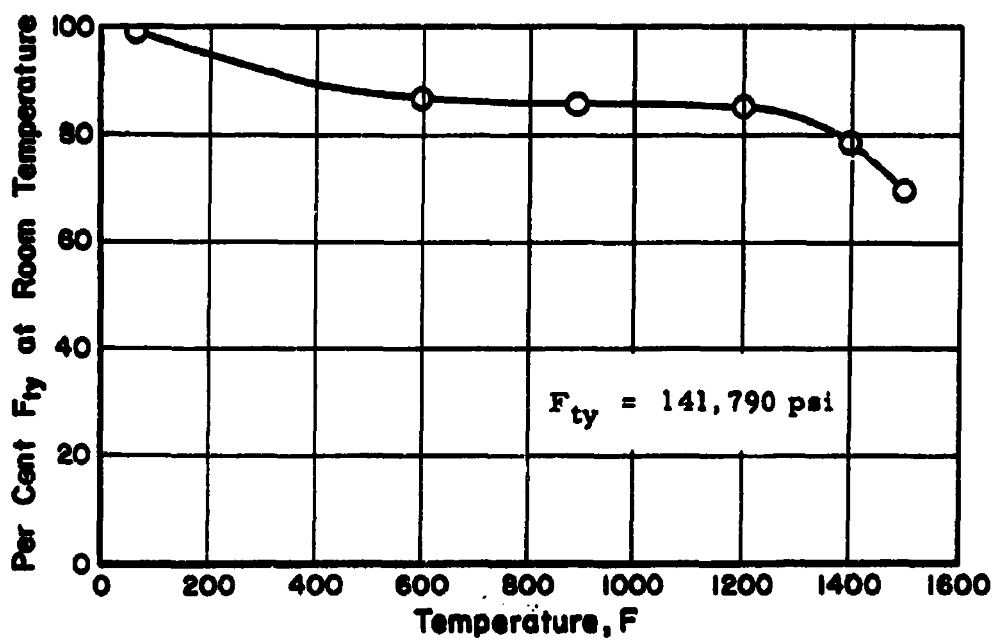


FIGURE 152. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

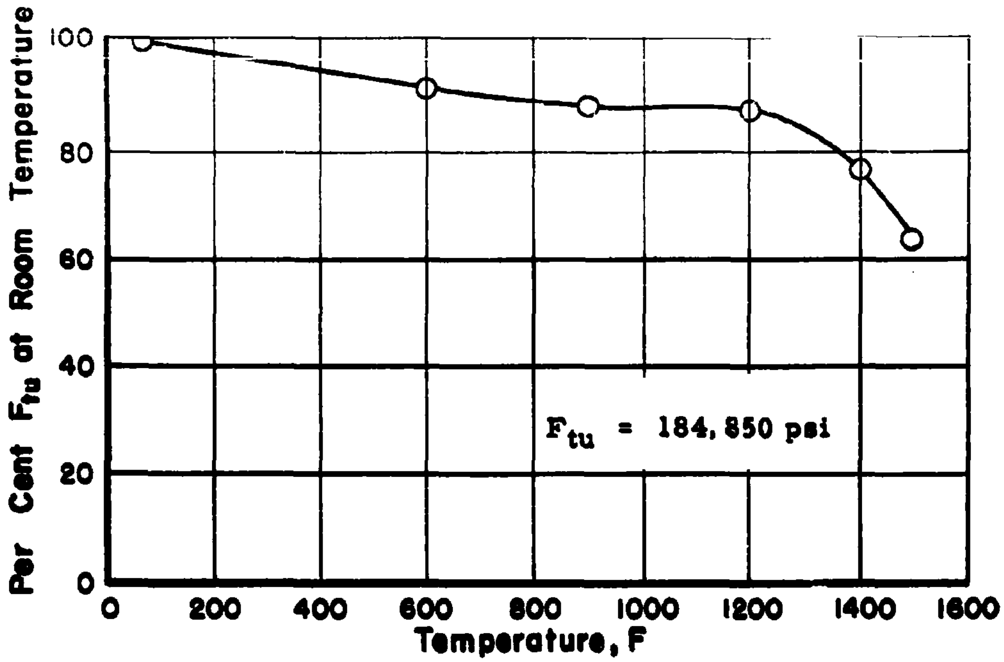


FIGURE 153. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

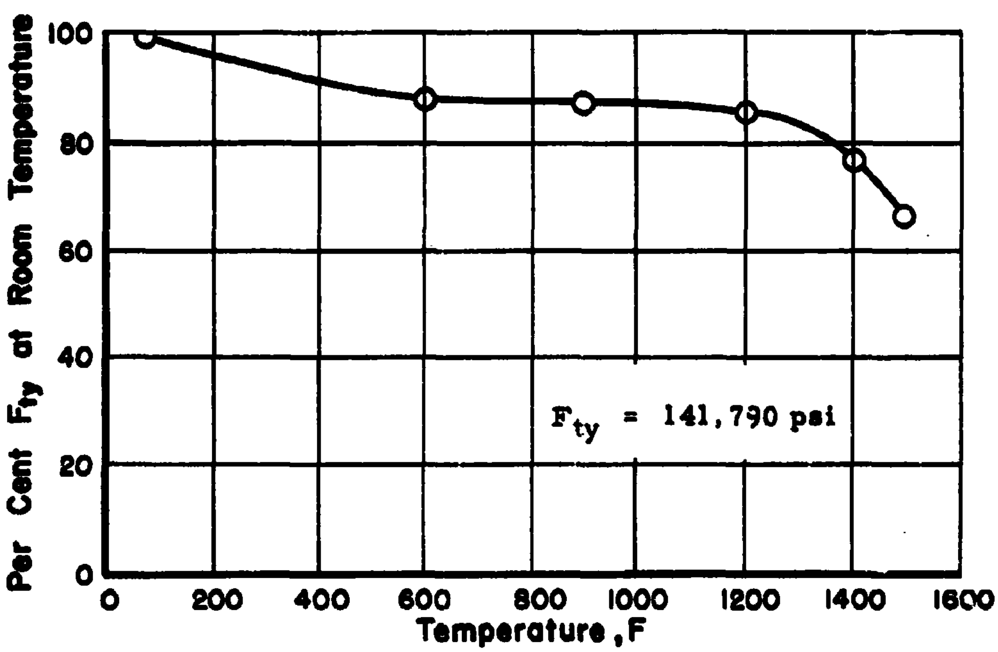


FIGURE 154. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF RENE 41 EXPOSED 100 HOURS

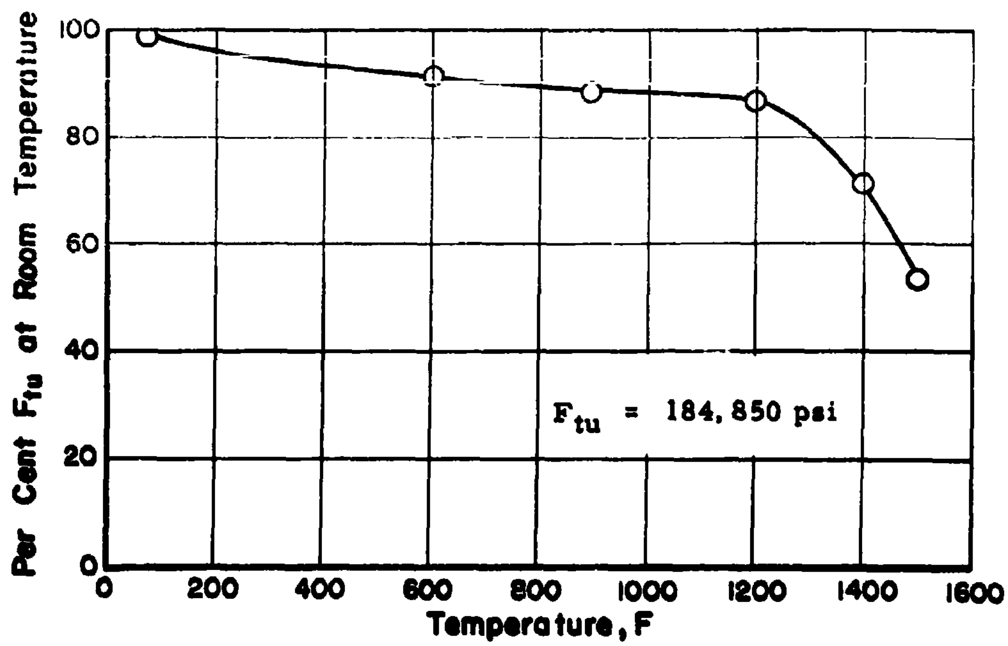


FIGURE 155. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

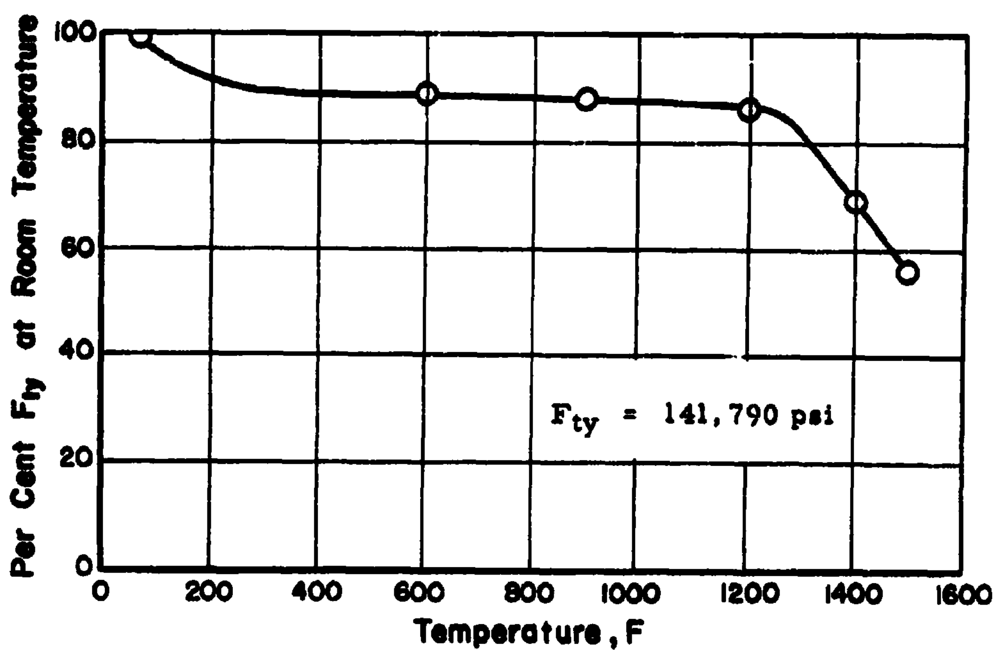


FIGURE 156. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

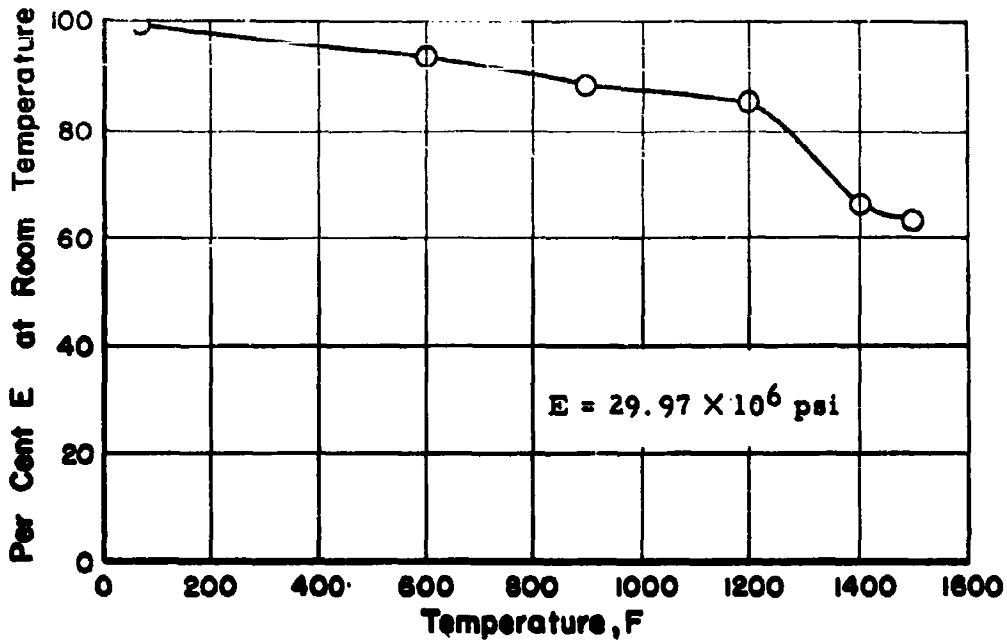


FIGURE 157. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 0.5 HOURS

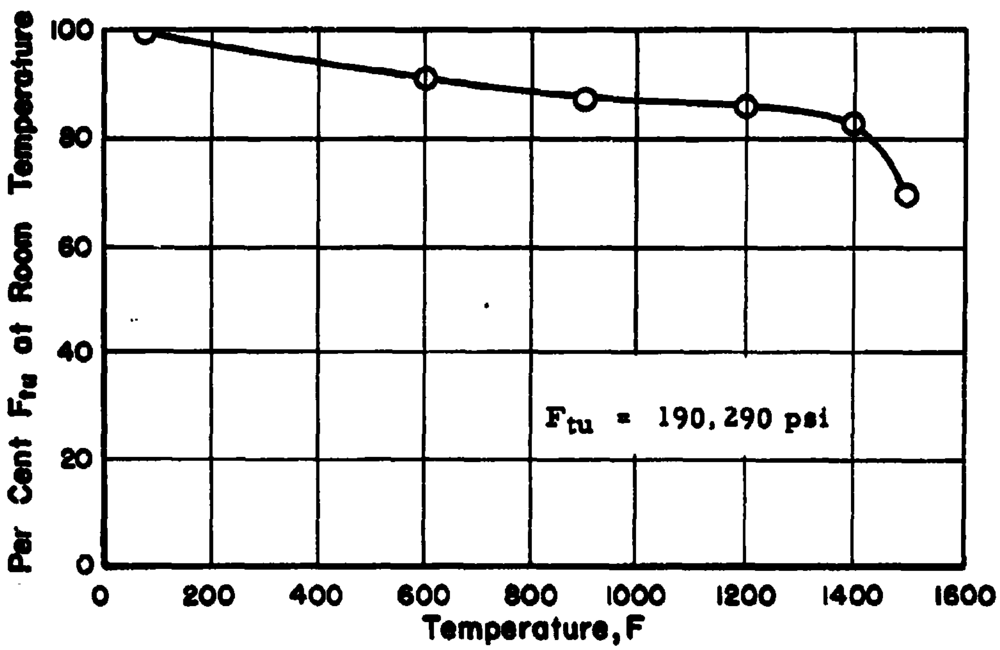


FIGURE 158. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

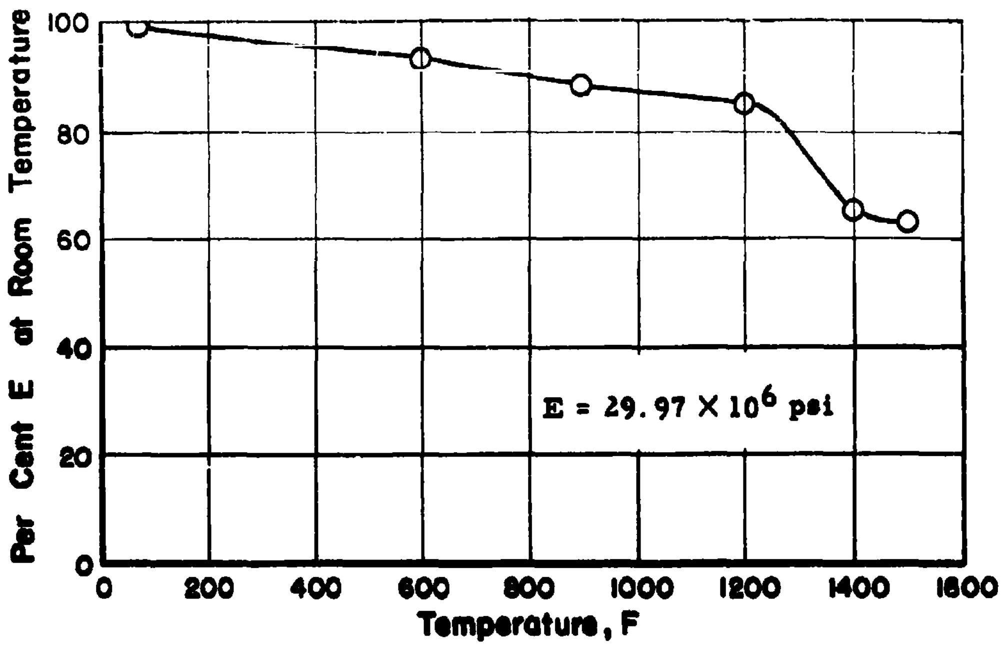


FIGURE 159. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 10 HOURS

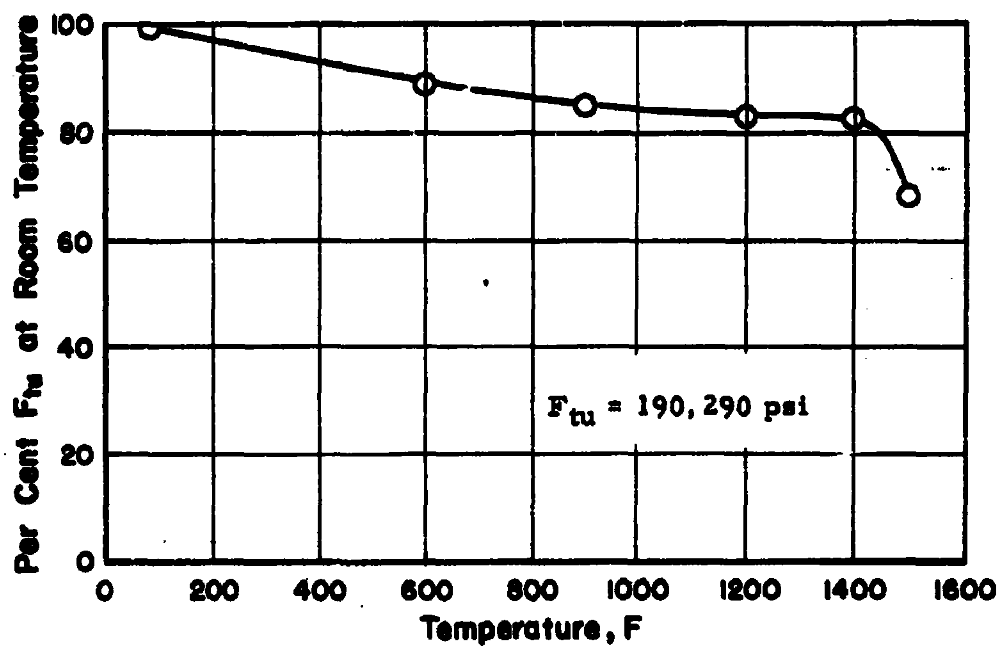


FIGURE 160. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

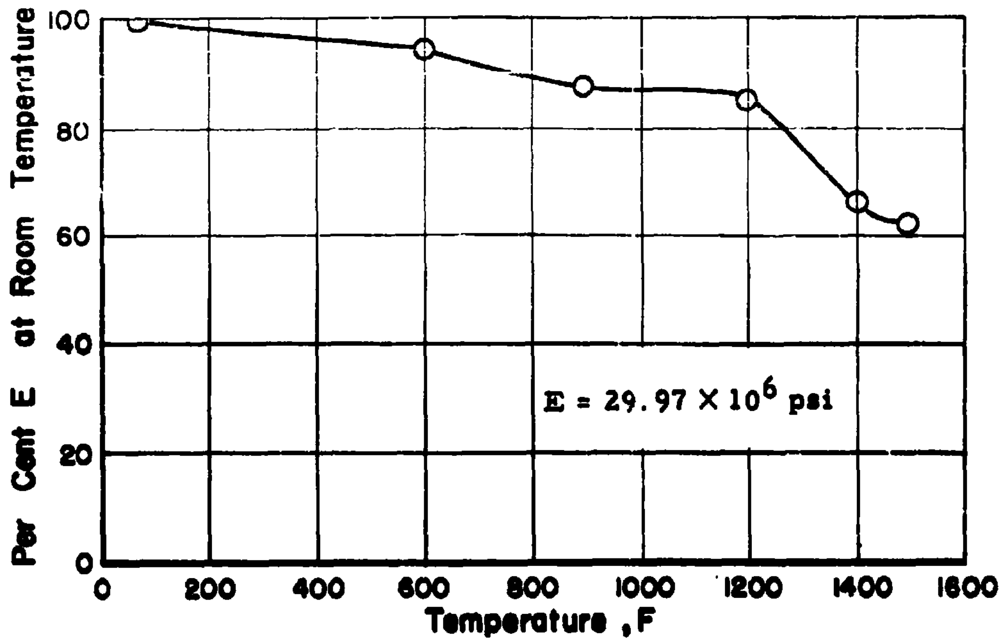


**FIGURE 161. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 100 HOURS**

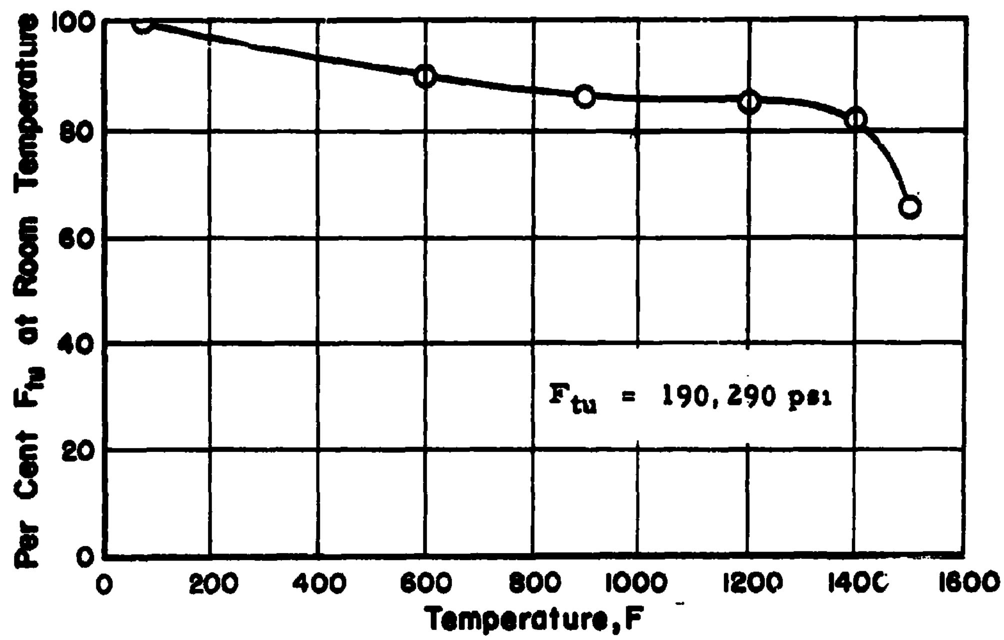


FIGURE 162. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

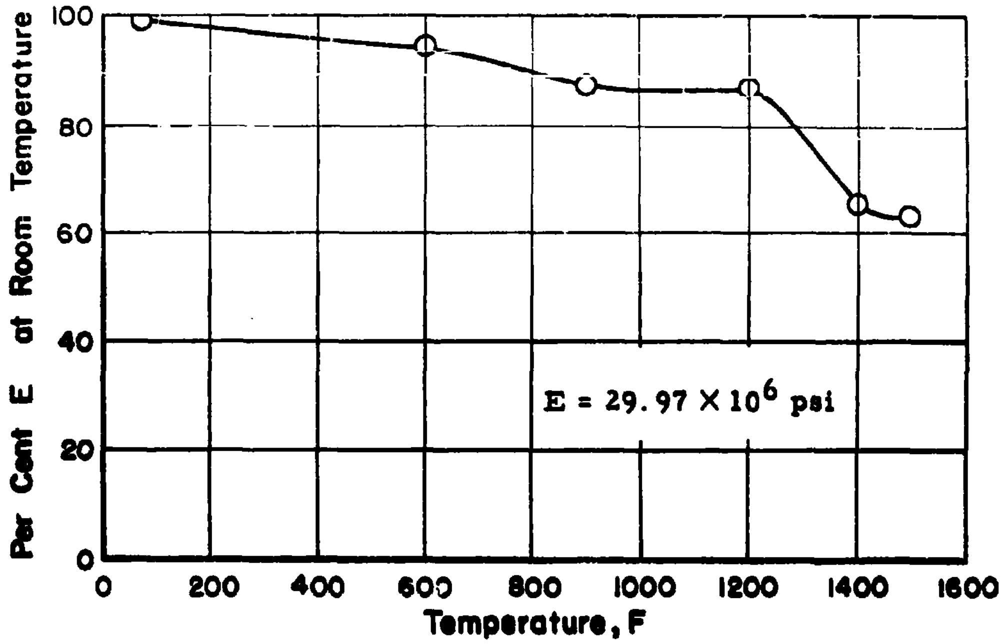


FIGURE 163. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 1000 HOURS

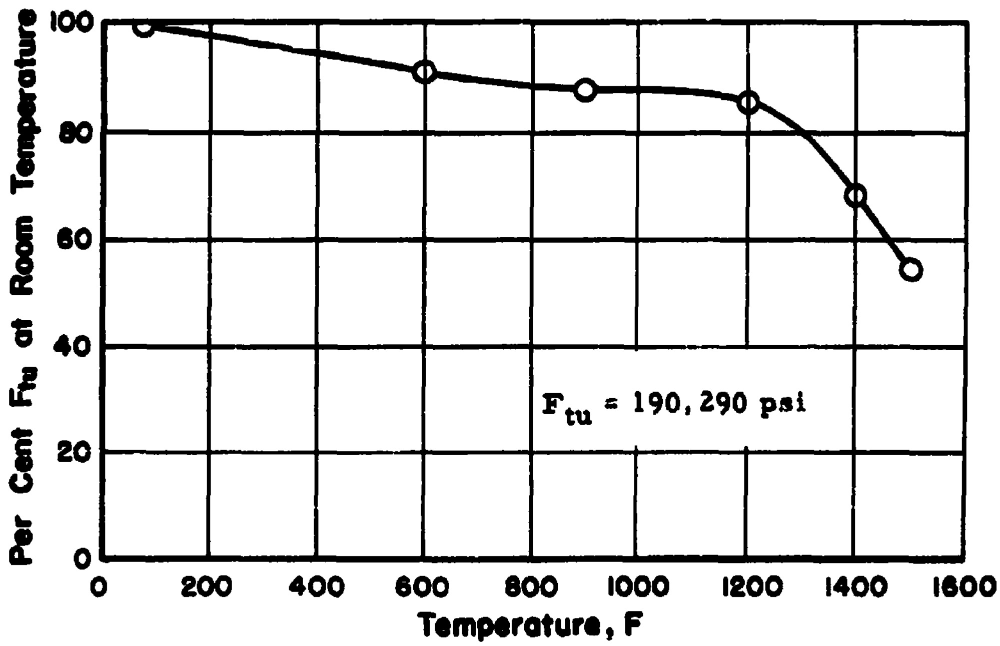


FIGURE 164. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

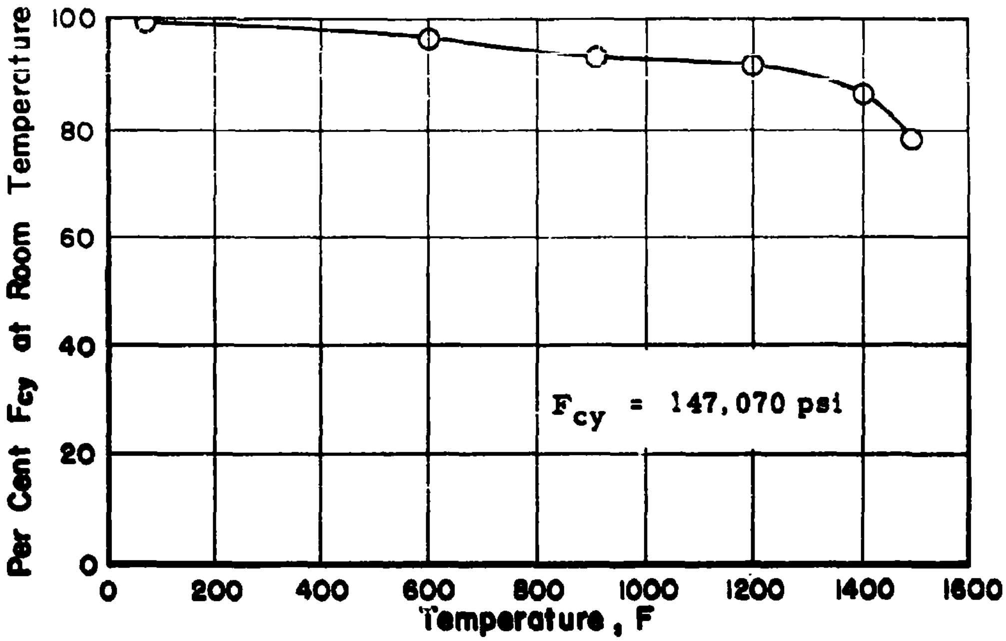


FIGURE 165. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

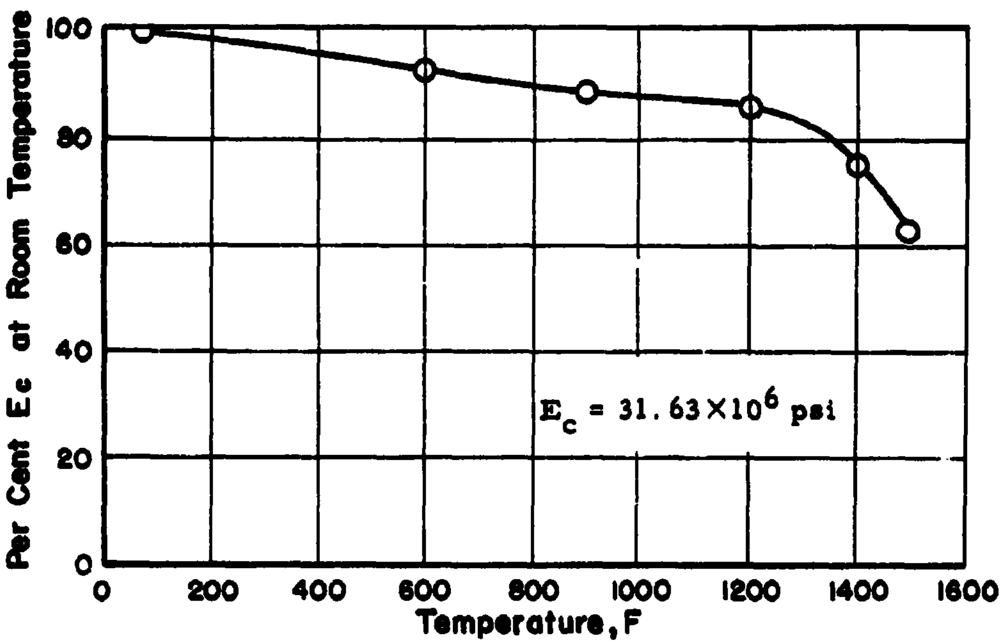


FIGURE 166. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 0.5 HOURS

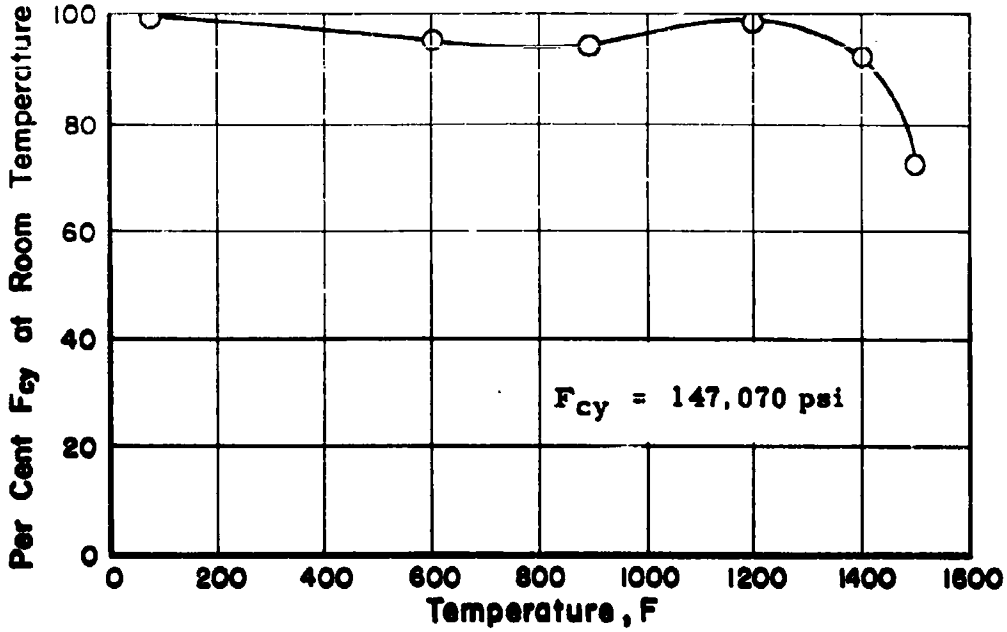


FIGURE 167. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

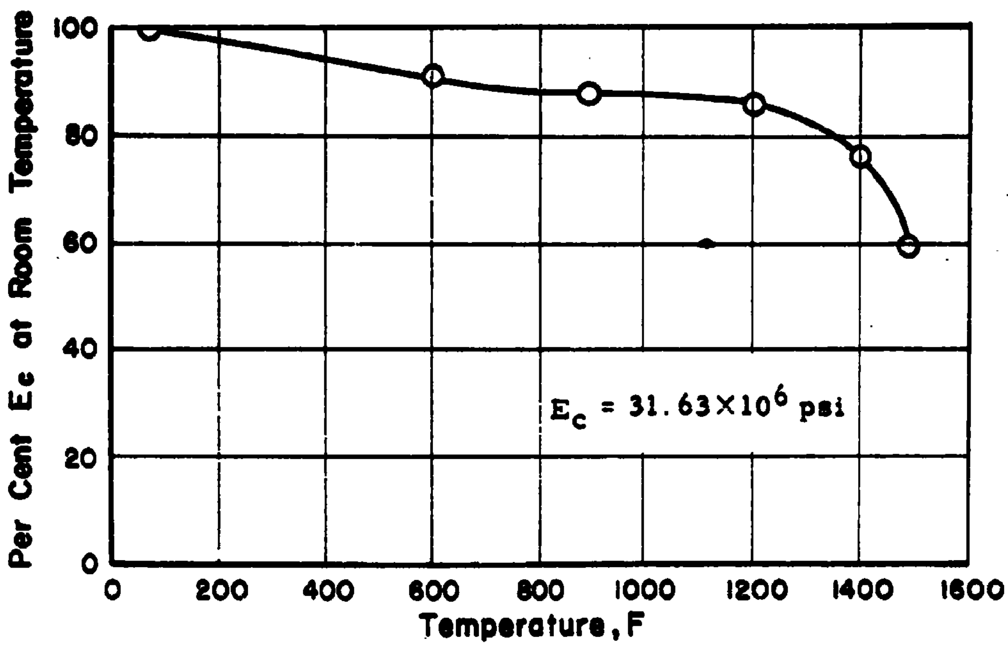


FIGURE 168. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 10 HOURS

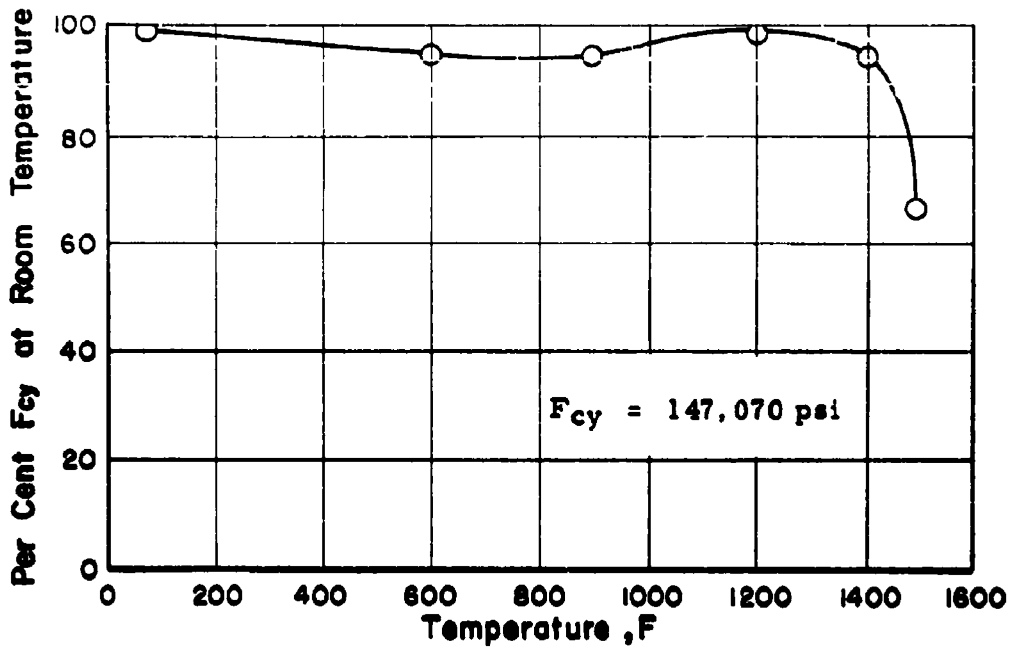


FIGURE 169. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

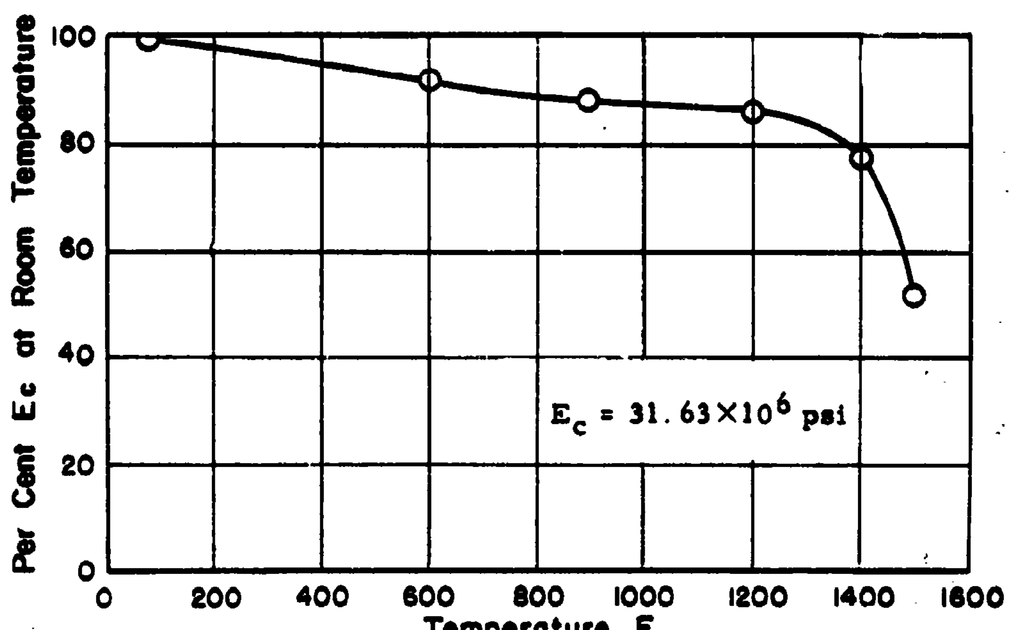


FIGURE 170. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 100 HOURS

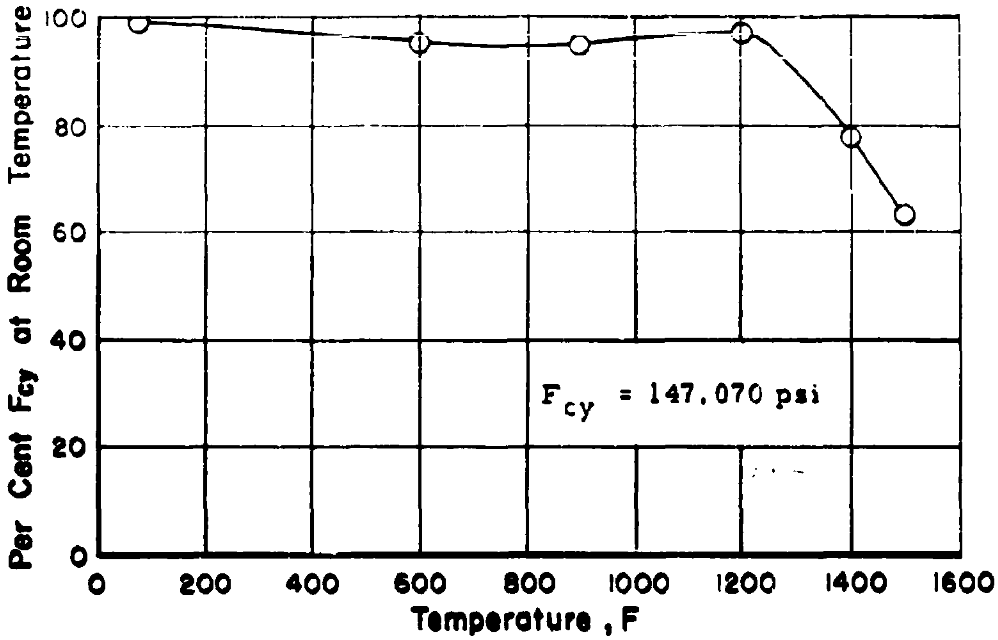


FIGURE 171. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

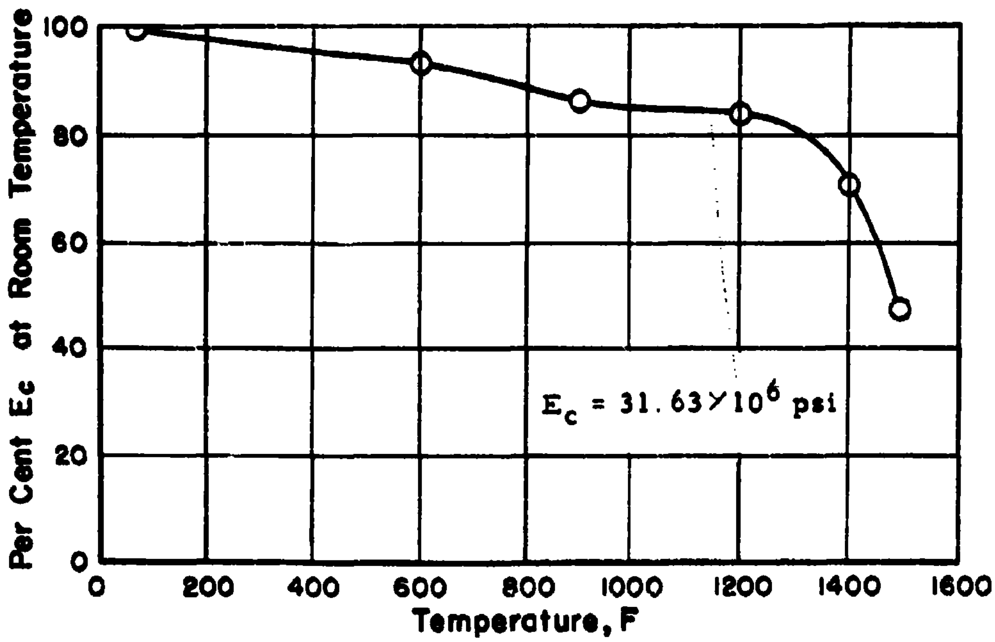


FIGURE 172. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 1000 HOURS

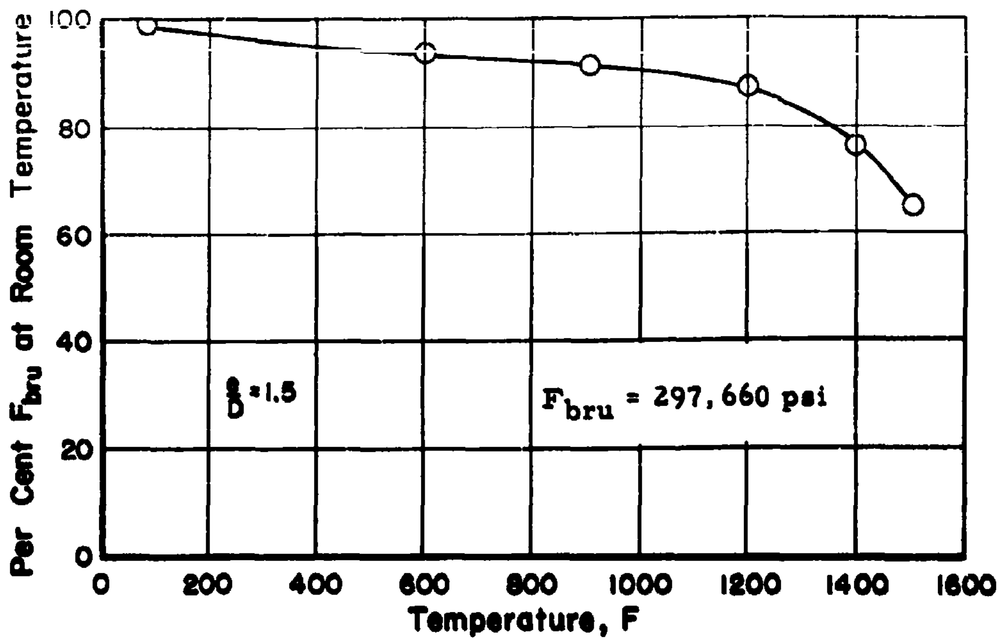


FIGURE 173. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

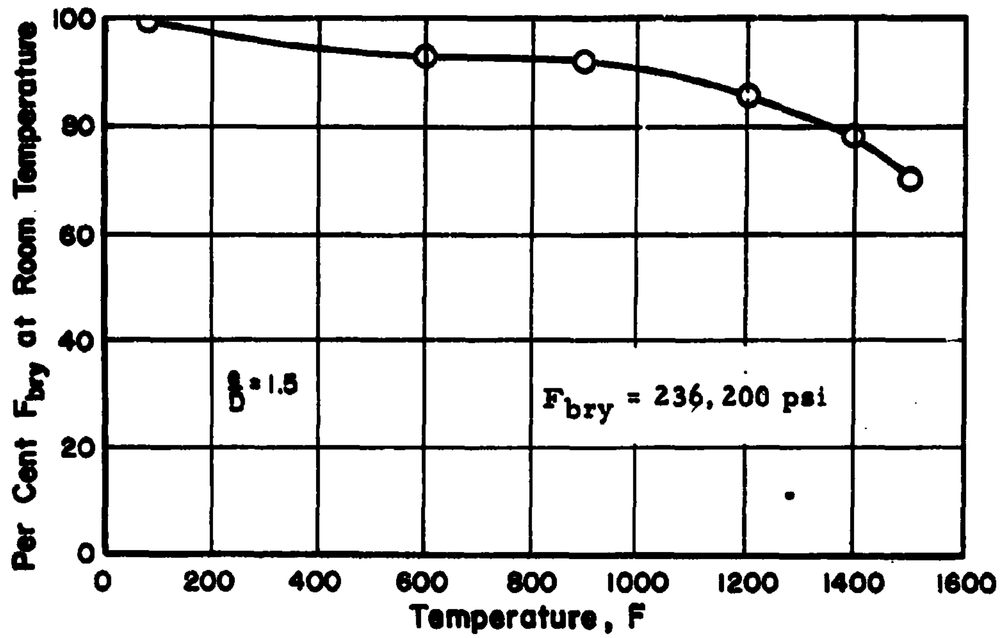


FIGURE 174. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

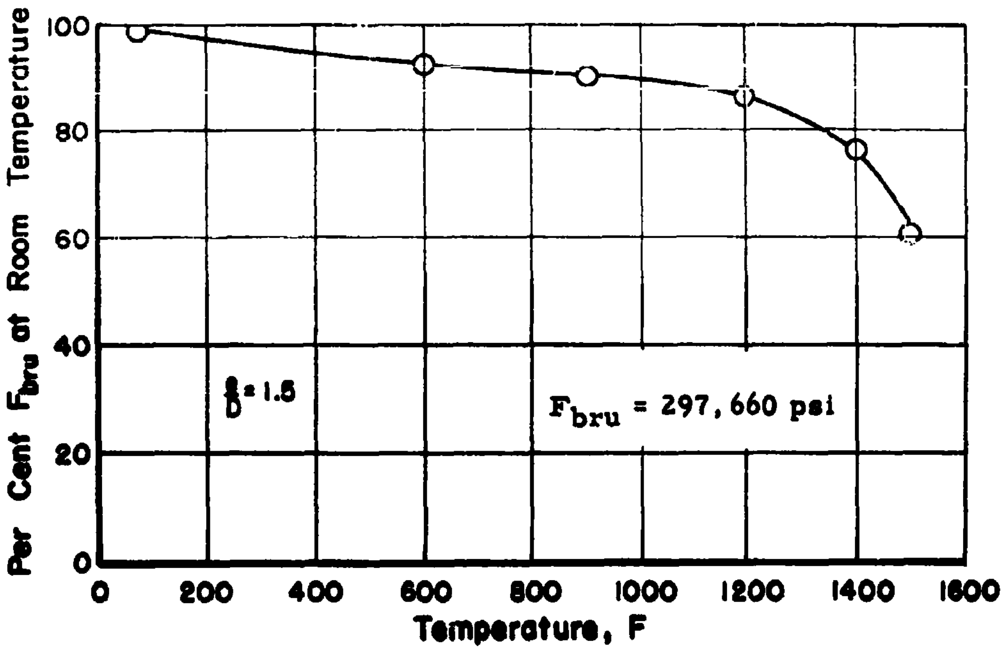


FIGURE 175. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

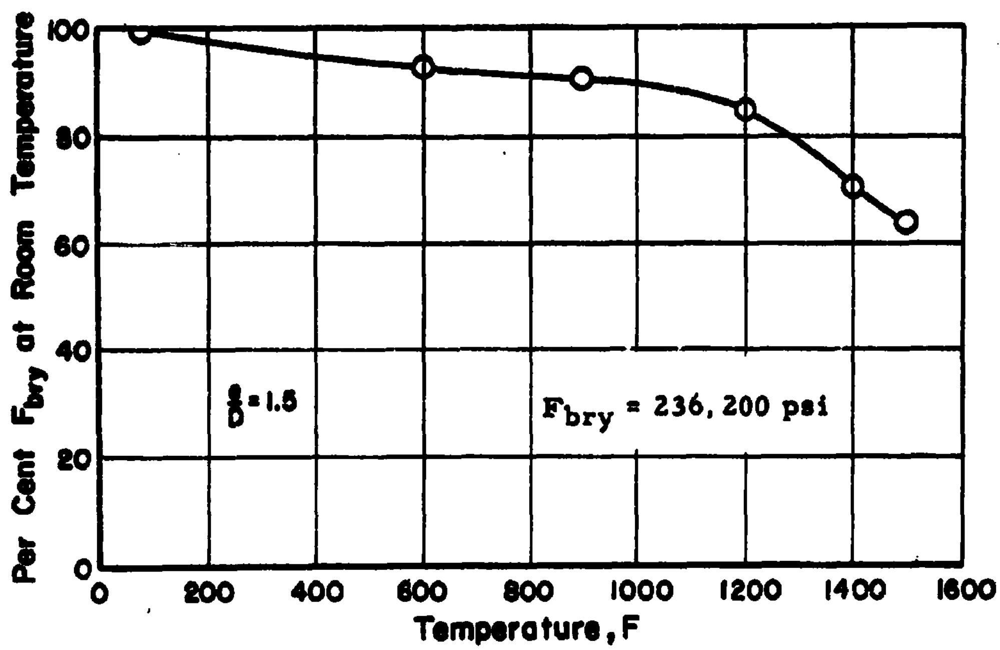


FIGURE 176. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

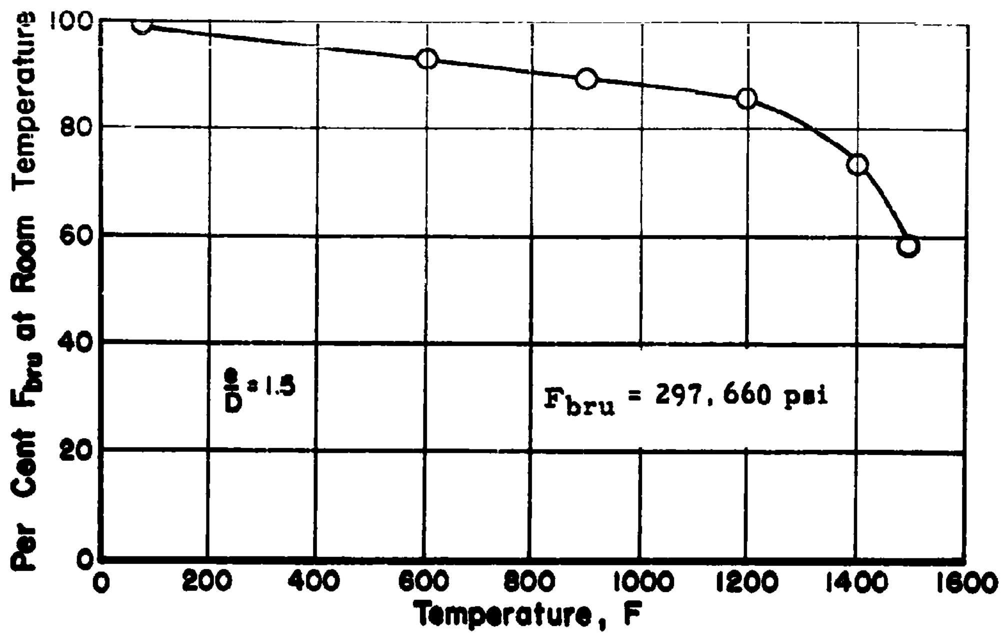


FIGURE 177. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

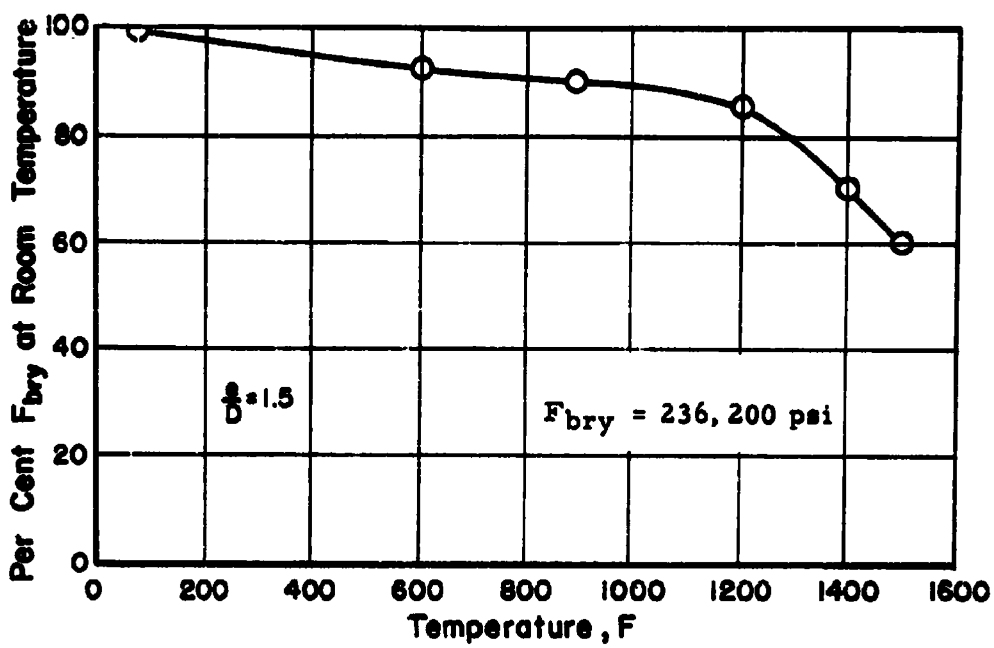


FIGURE 178. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

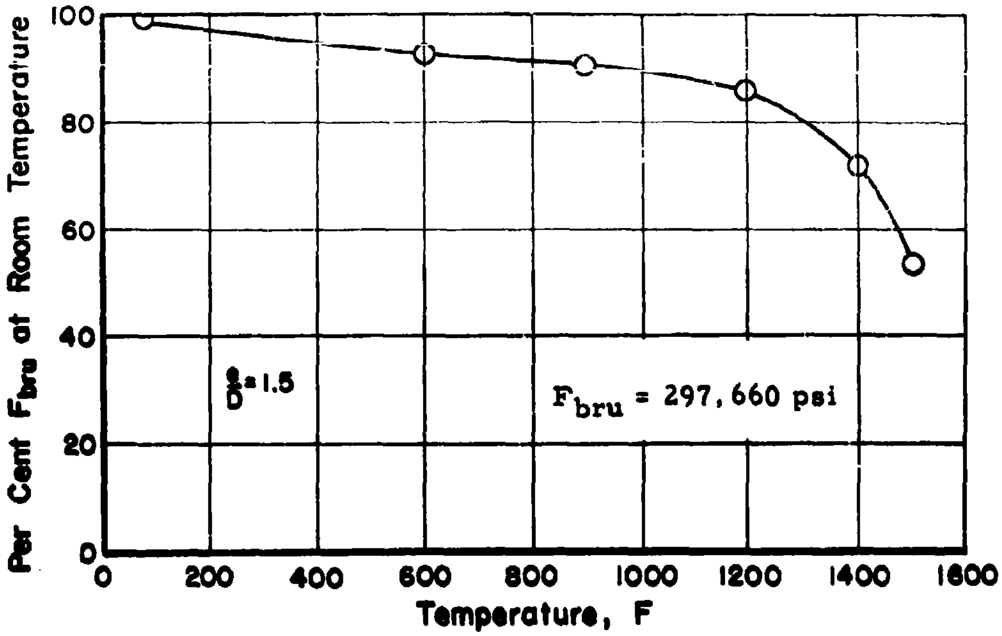


FIGURE 179. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

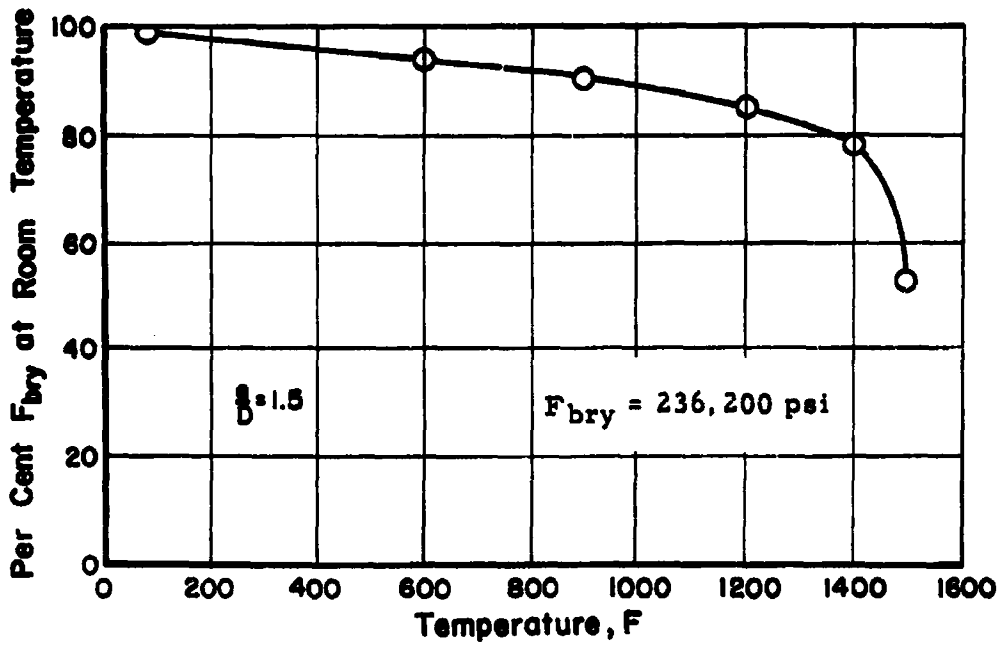


FIGURE 180. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

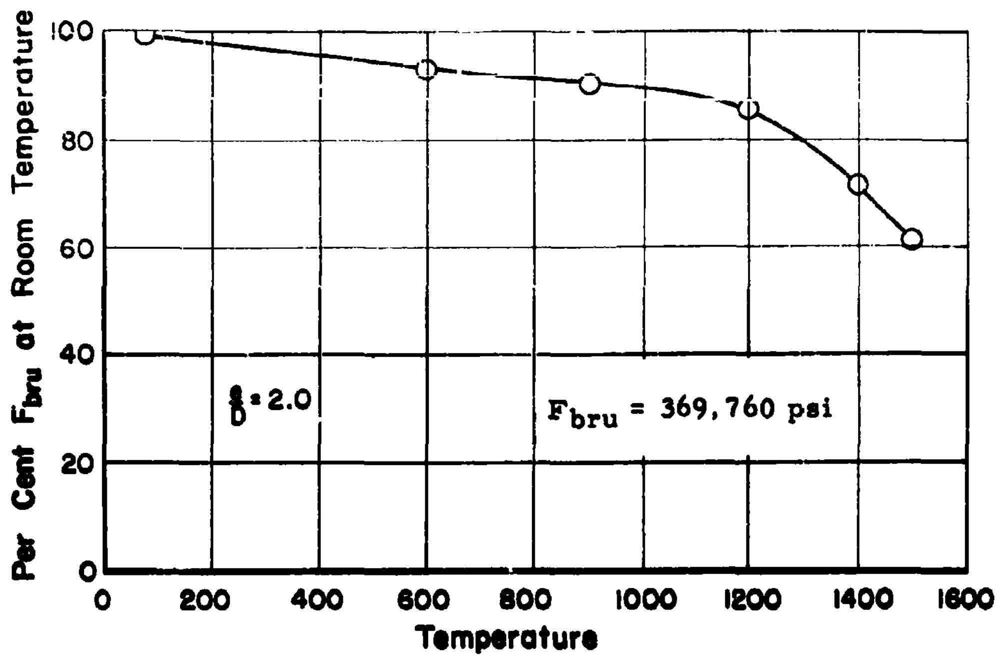


FIGURE 181. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

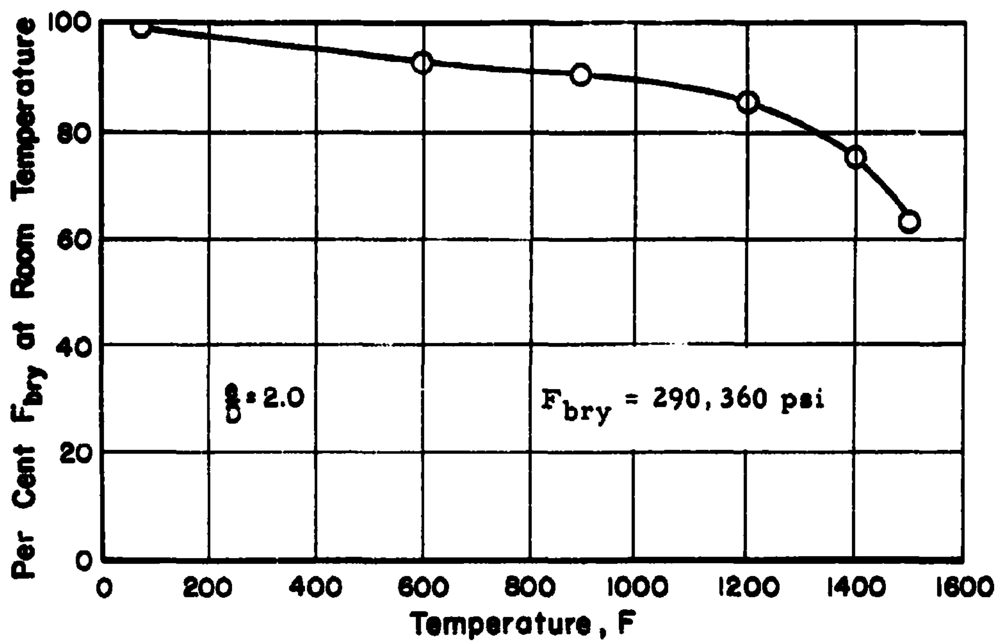


FIGURE 182. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

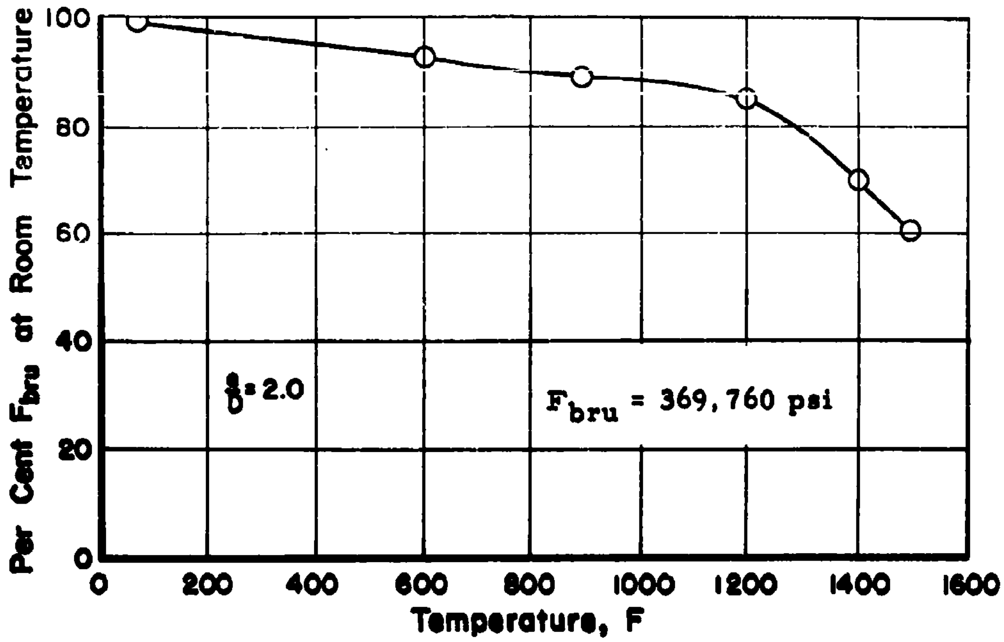


FIGURE 183. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

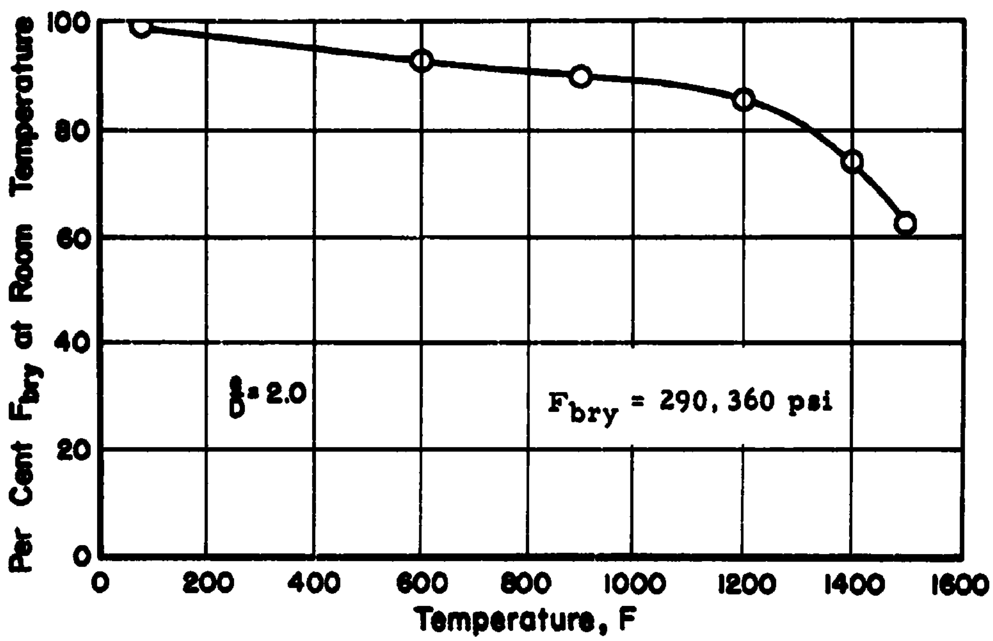


FIGURE 184. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

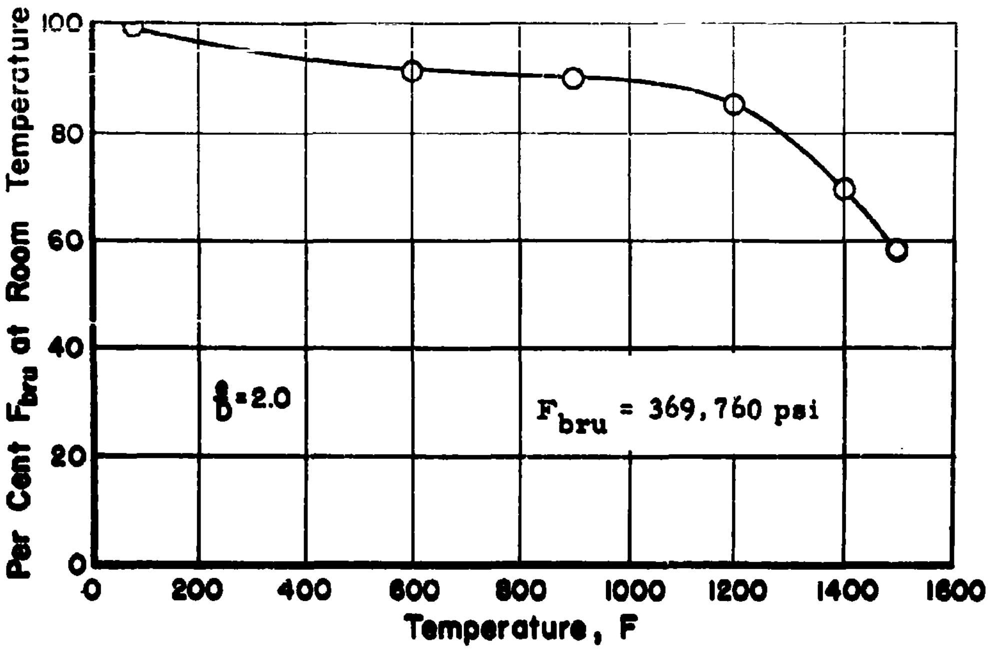


FIGURE 185. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

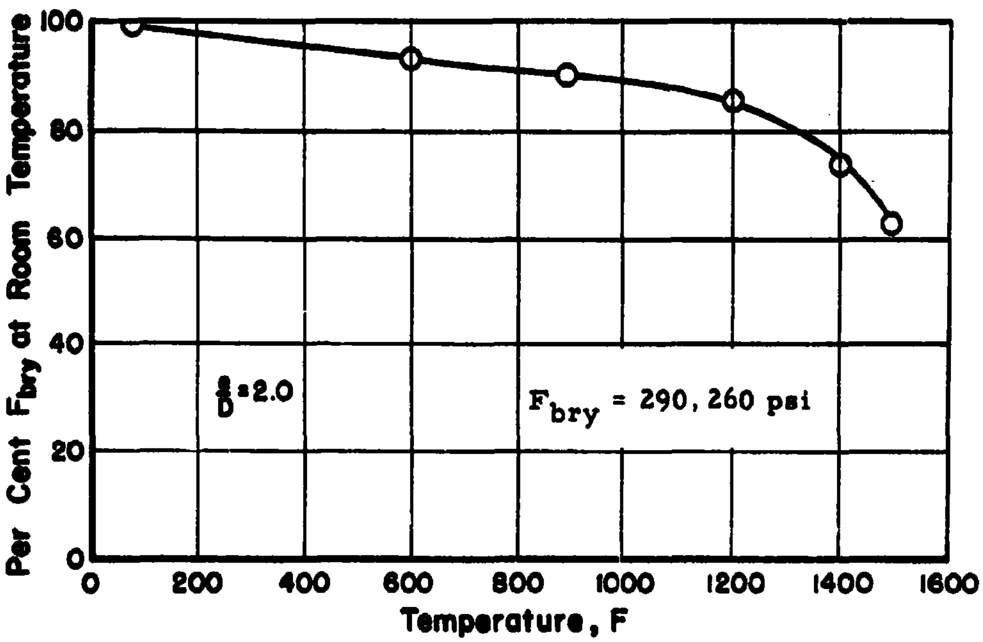


FIGURE 186. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

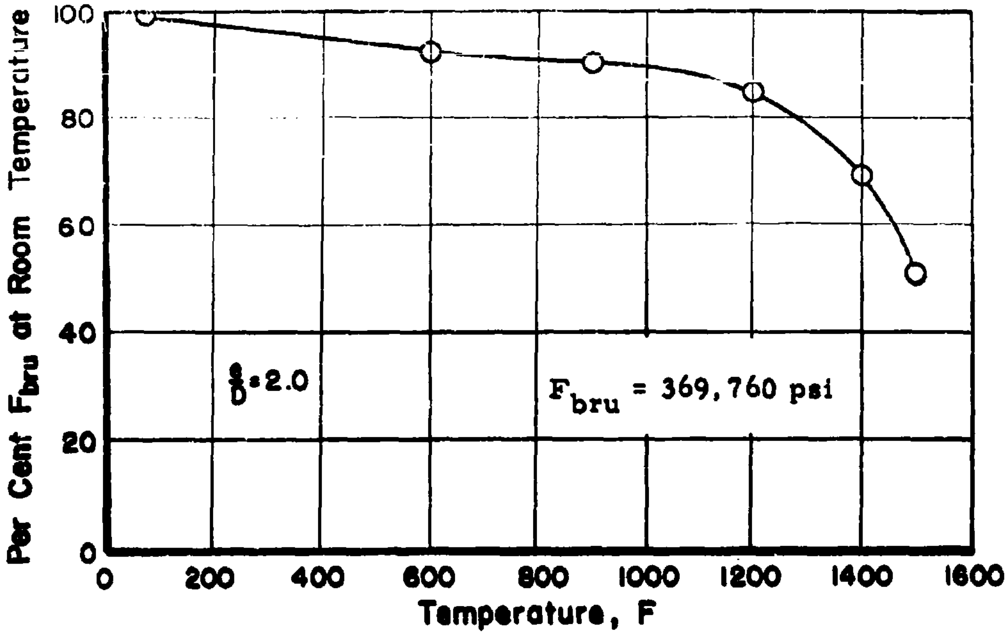


FIGURE 187. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

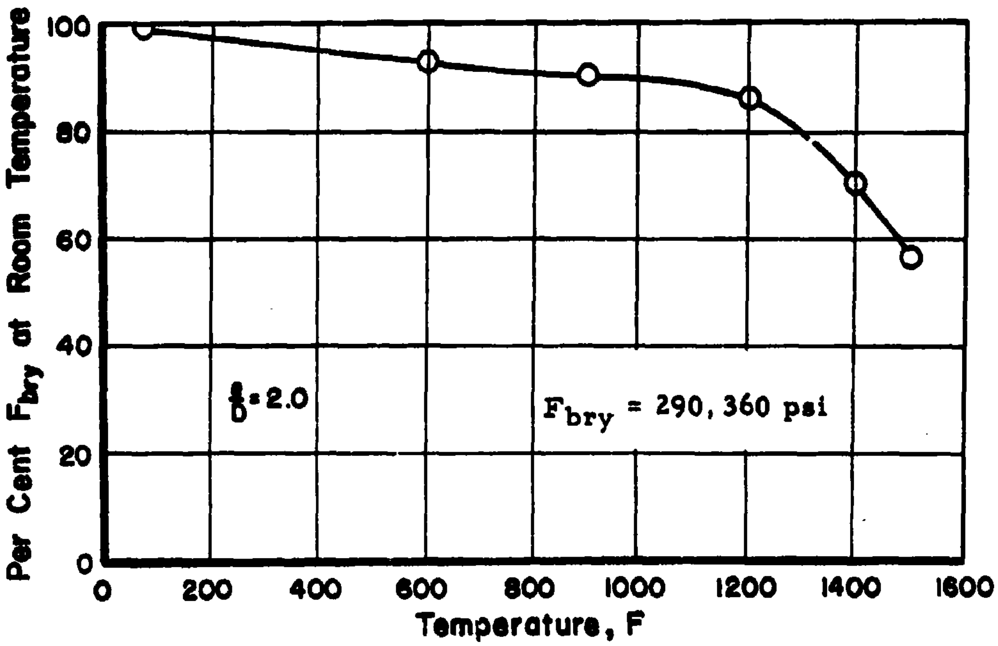


FIGURE 188. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

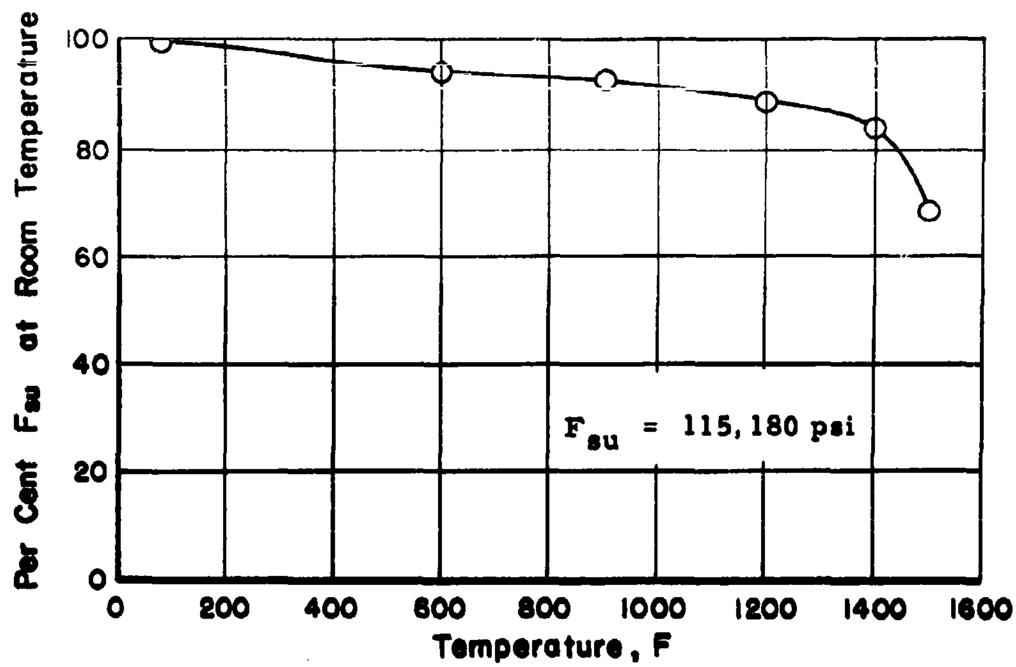


FIGURE 189. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

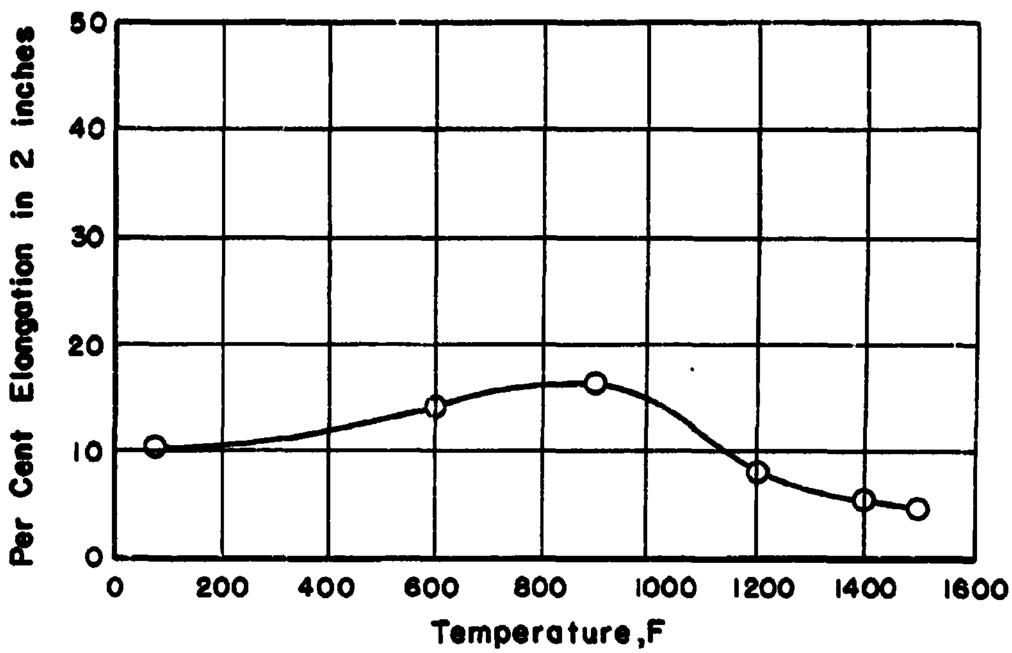


FIGURE 190. EFFECT OF TEMPERATURE ON ELONGATION OF RENÉ 41 EXPOSED 0.5 HOURS

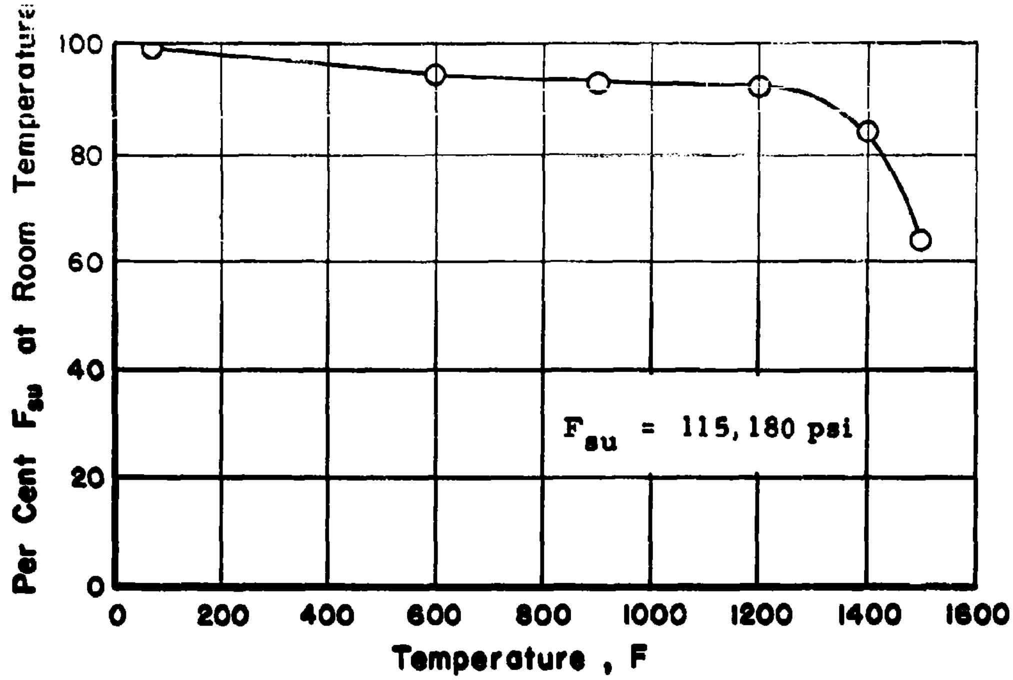


FIGURE 191. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

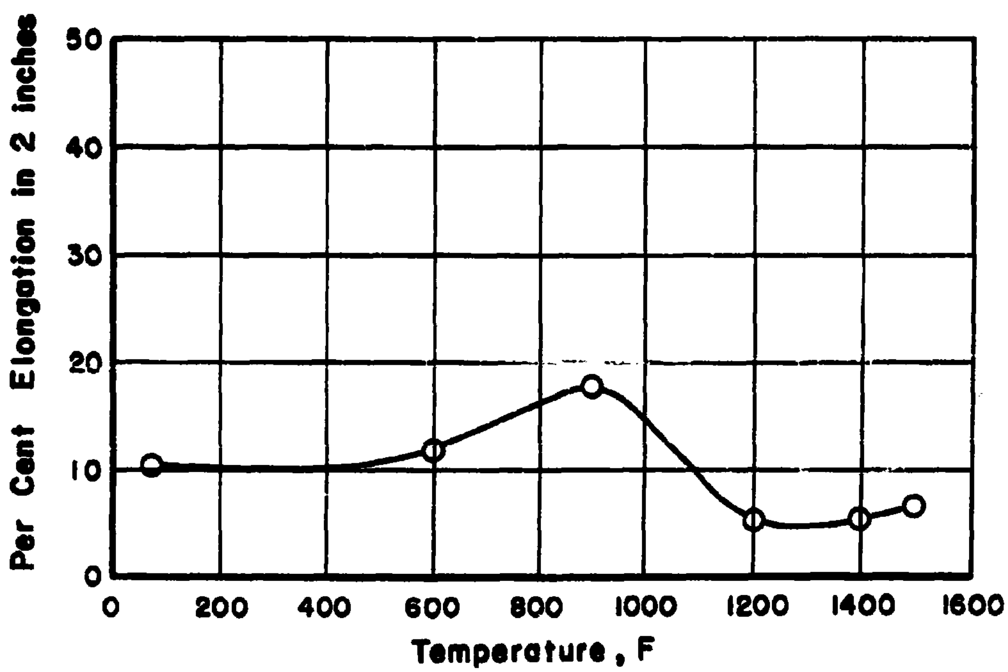


FIGURE 192. EFFECT OF TEMPERATURE ON ELONGATION OF RENÉ 41 EXPOSED 10 HOURS

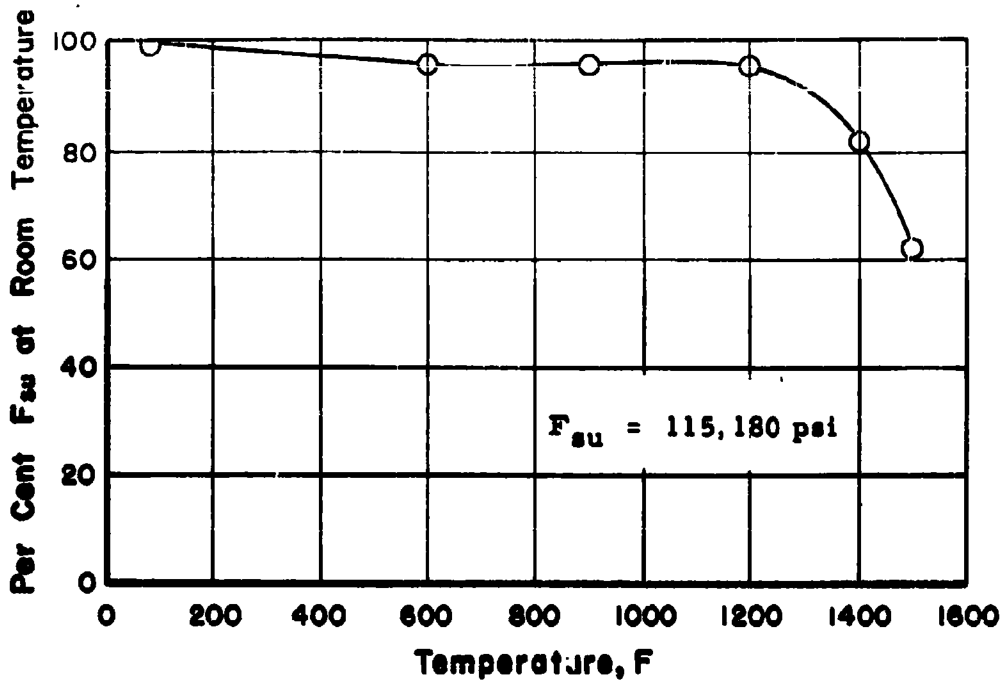


FIGURE 193. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

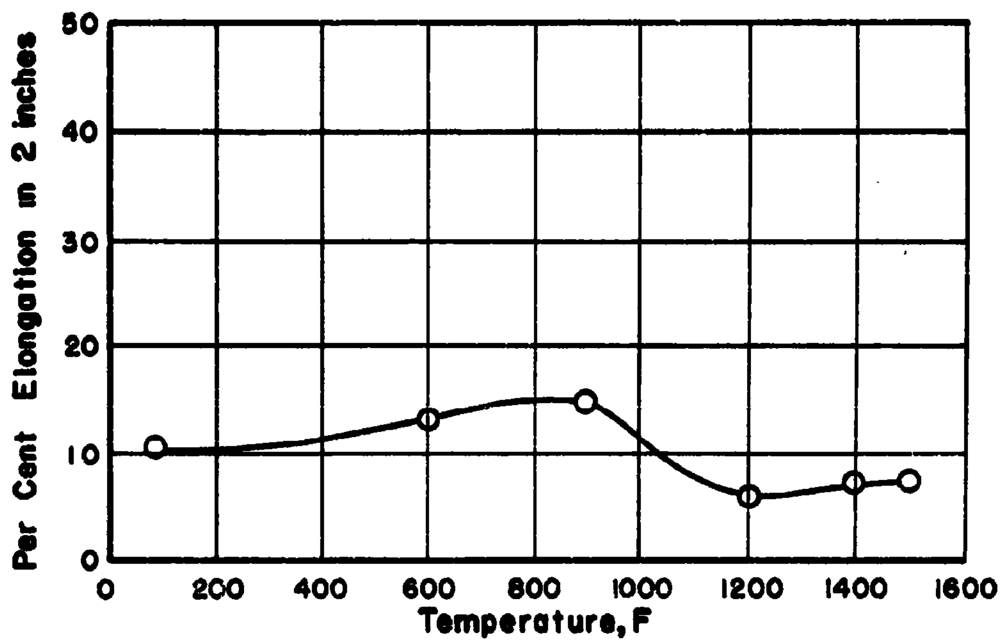


FIGURE 194. EFFECT OF TEMPERATURE ON ELONGATION OF RENÉ 41 EXPOSED 100 HOURS

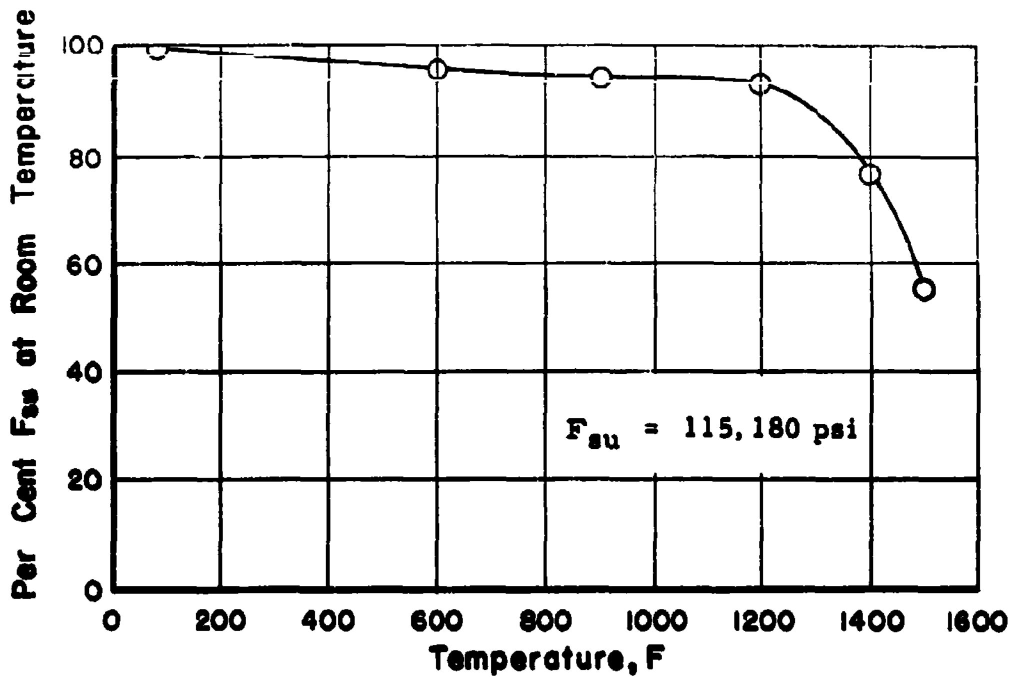


FIGURE 195. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

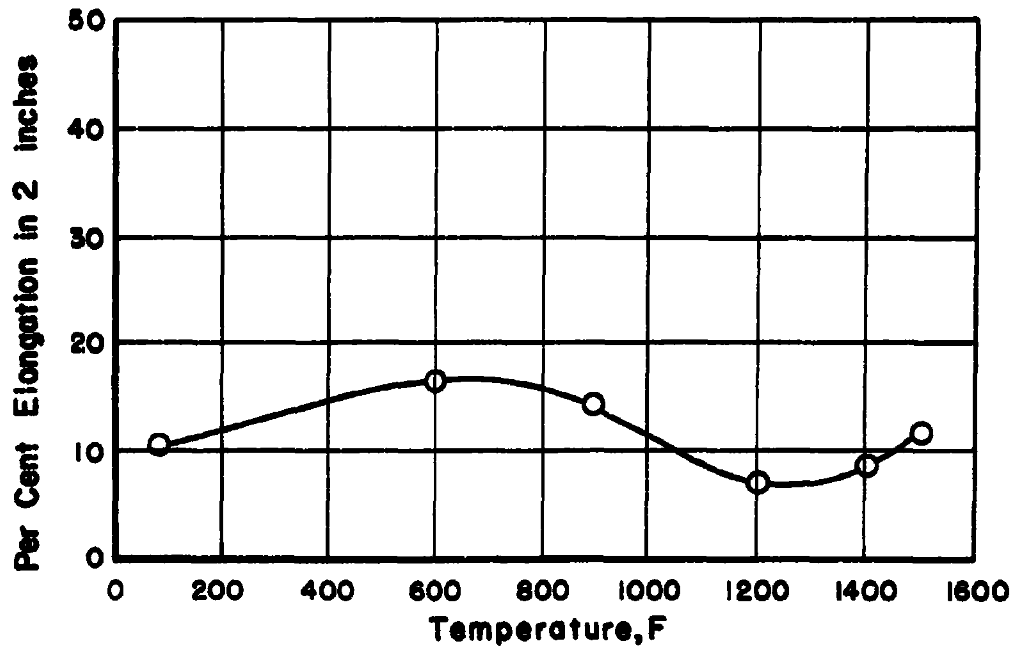


FIGURE 196. EFFECT OF TEMPERATURE ON ELONGATION OF RENÉ 41 EXPOSED 1000 HOURS

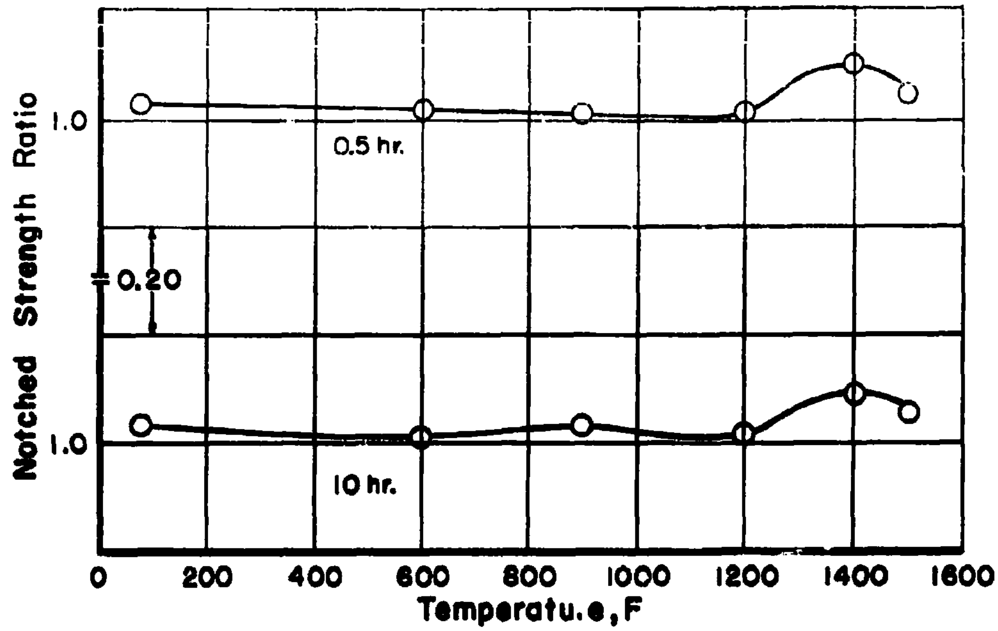


FIGURE 197. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF RENÉ 41 EXPOSED 0.5 AND 10 HOURS

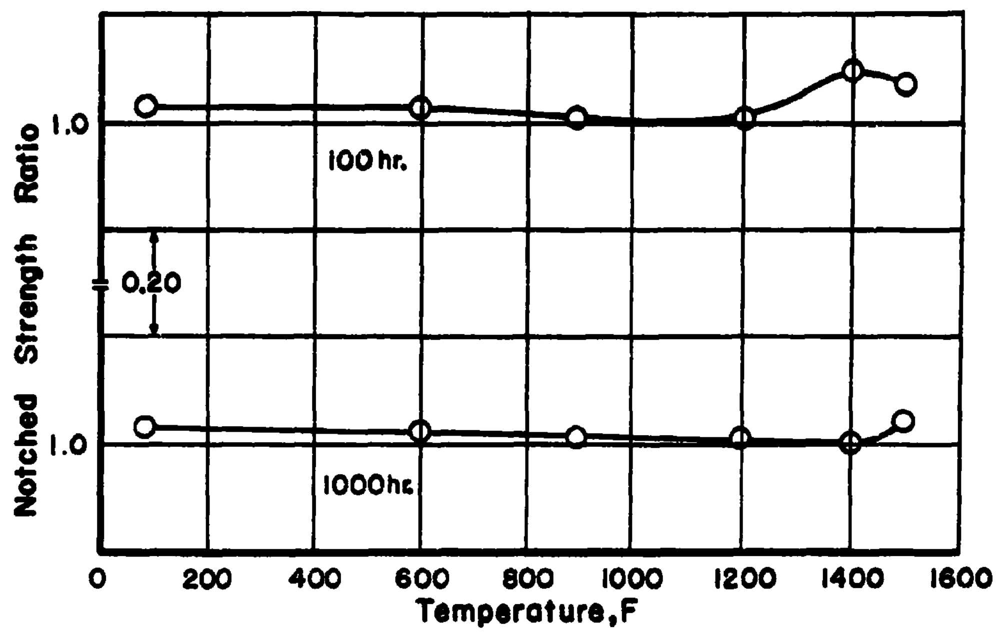


FIGURE 198. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF RENÉ 41 EXPOSED 100 AND 1000 HOURS

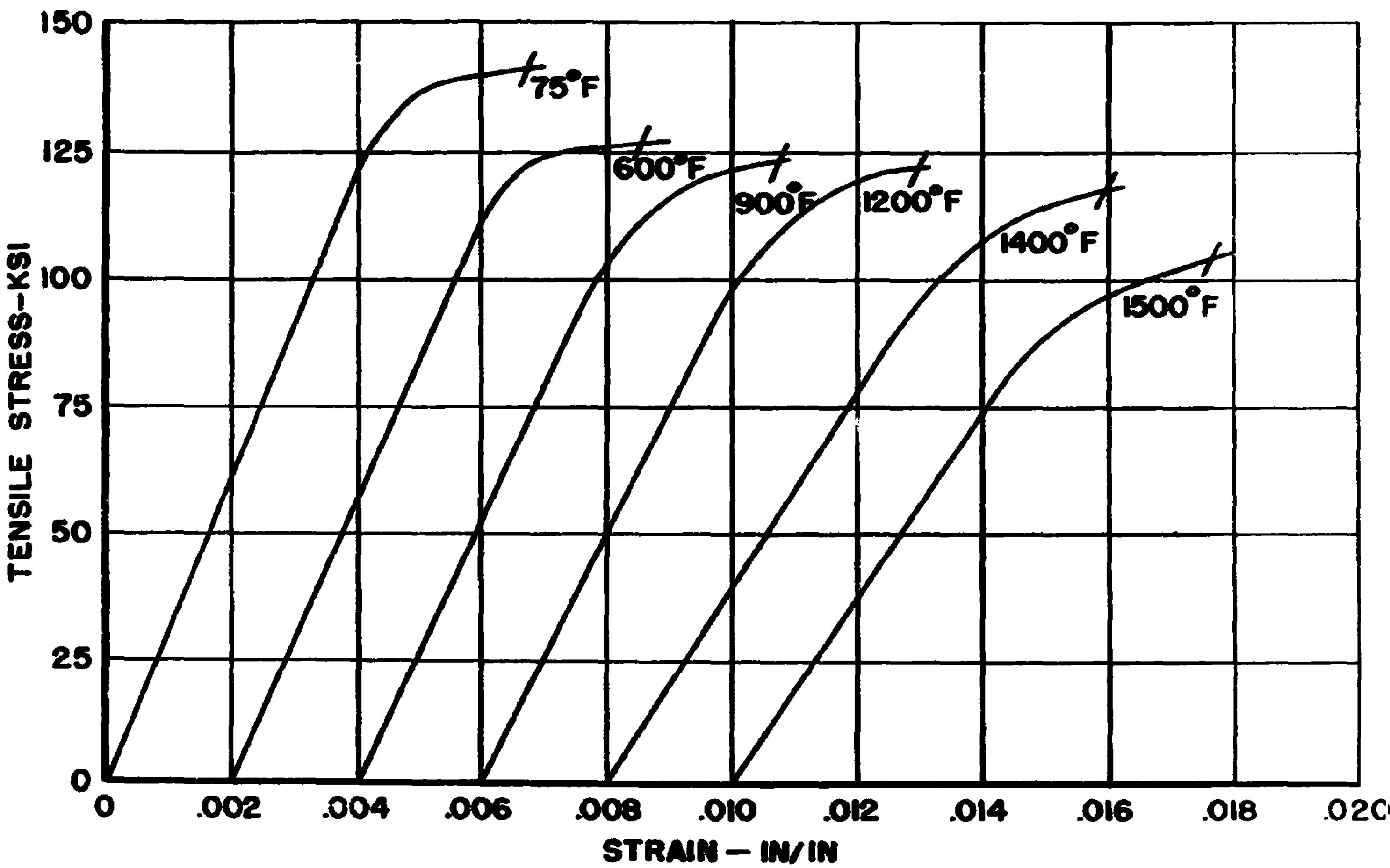


FIGURE 199. TENSILE STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 0. 5 HOURS

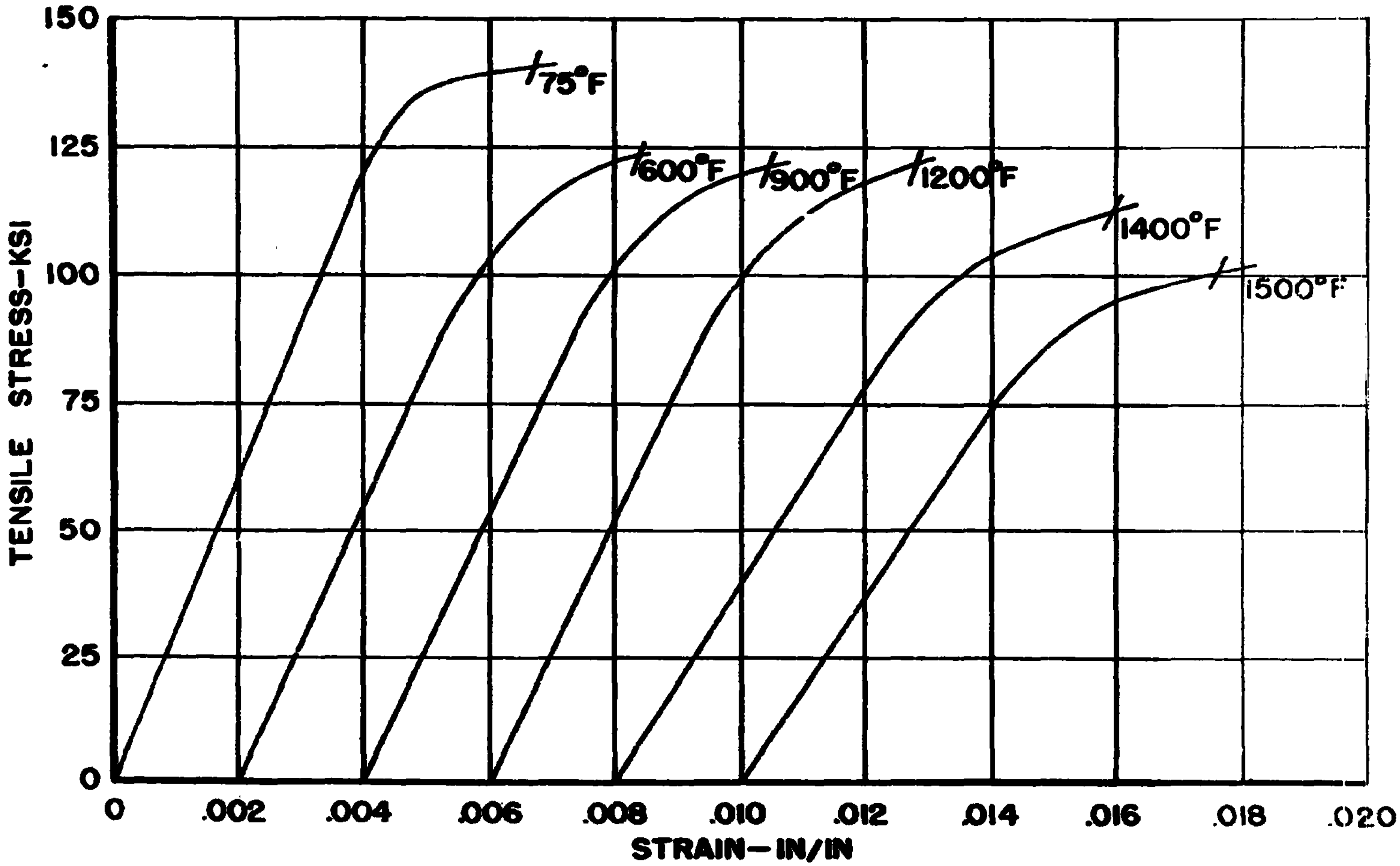


FIGURE 200. TENSILE STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 10 HOURS

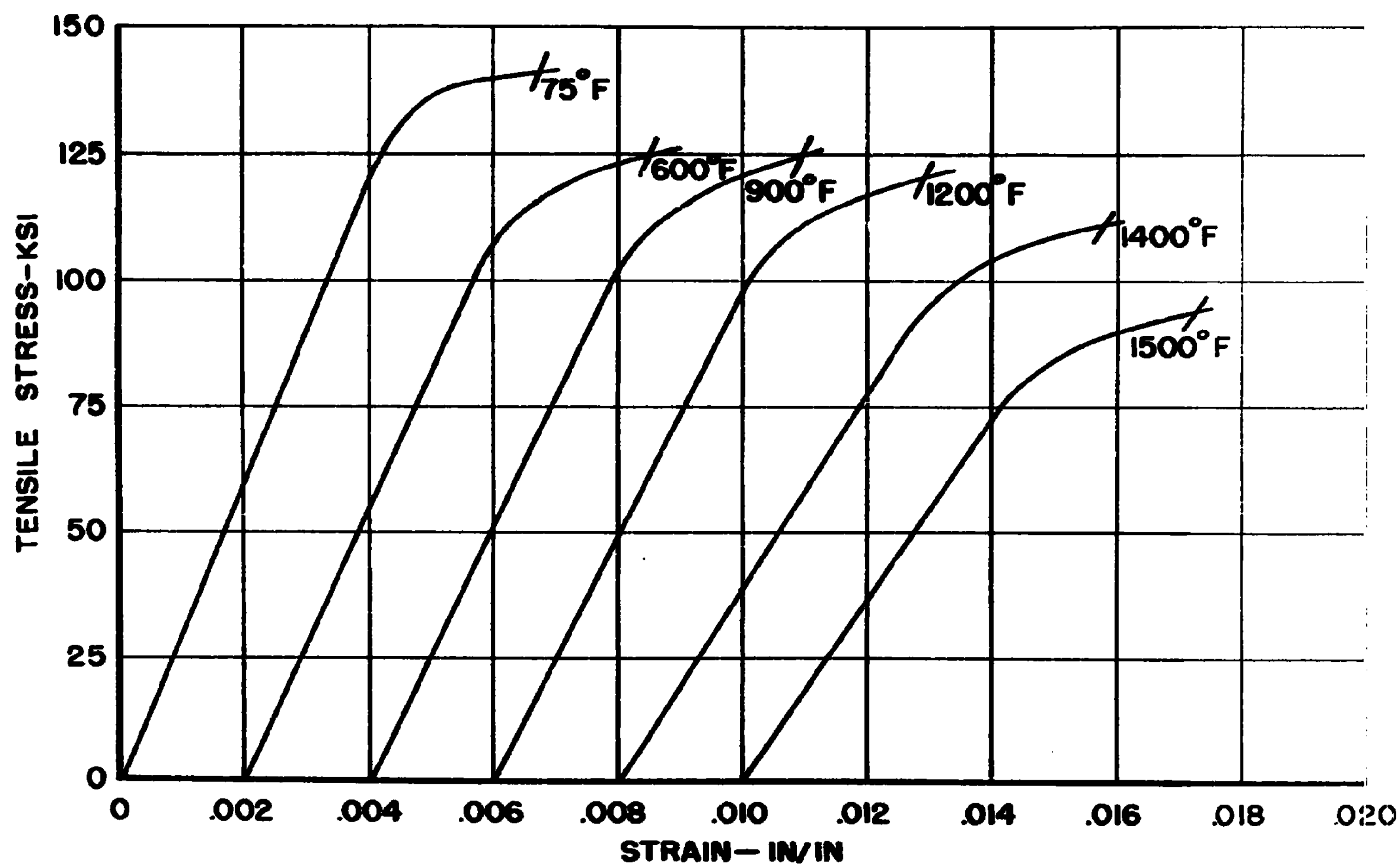


FIGURE 201. TENSILE STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 100 HOURS

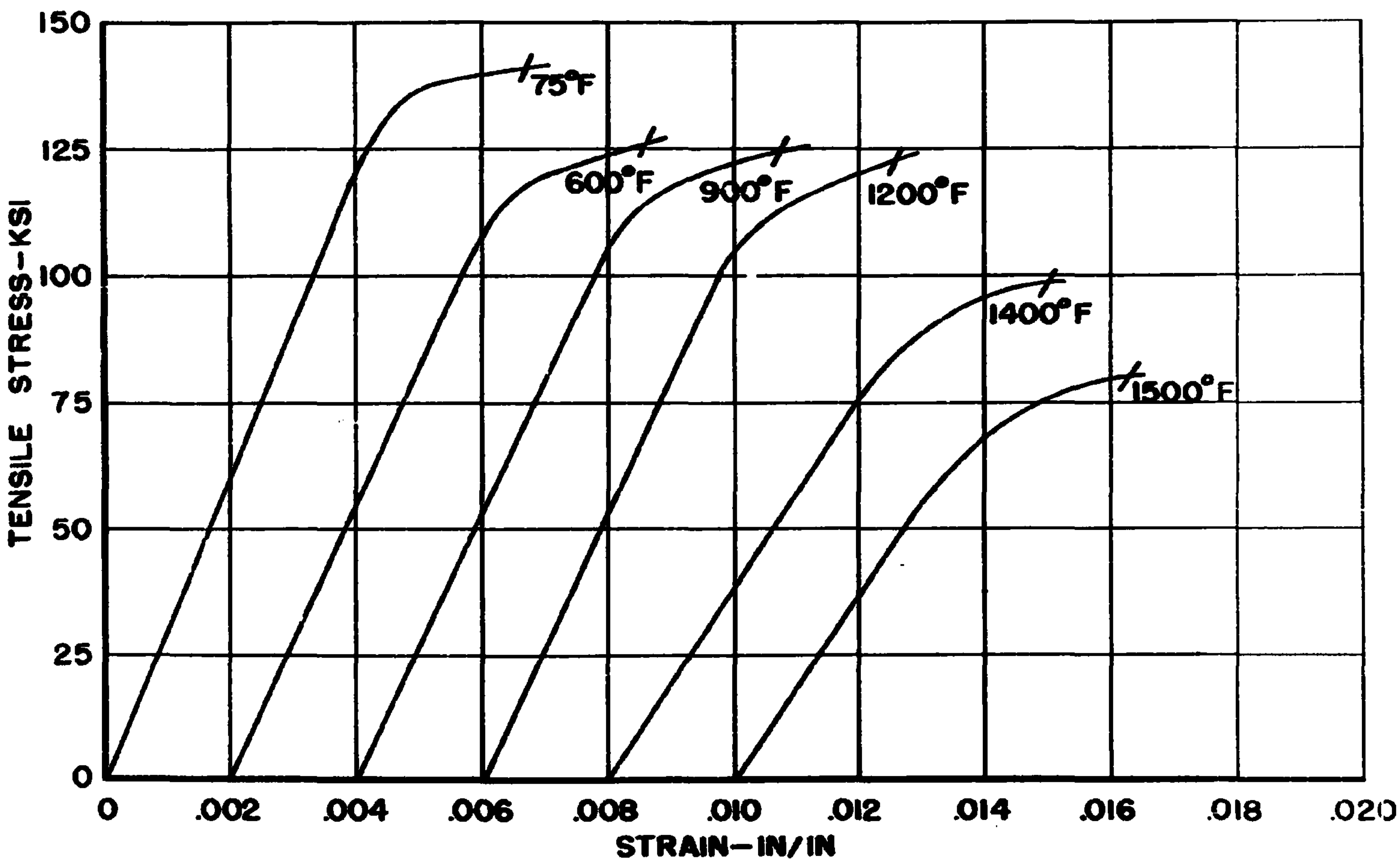


FIGURE 202. TENSILE STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 1000 HOURS

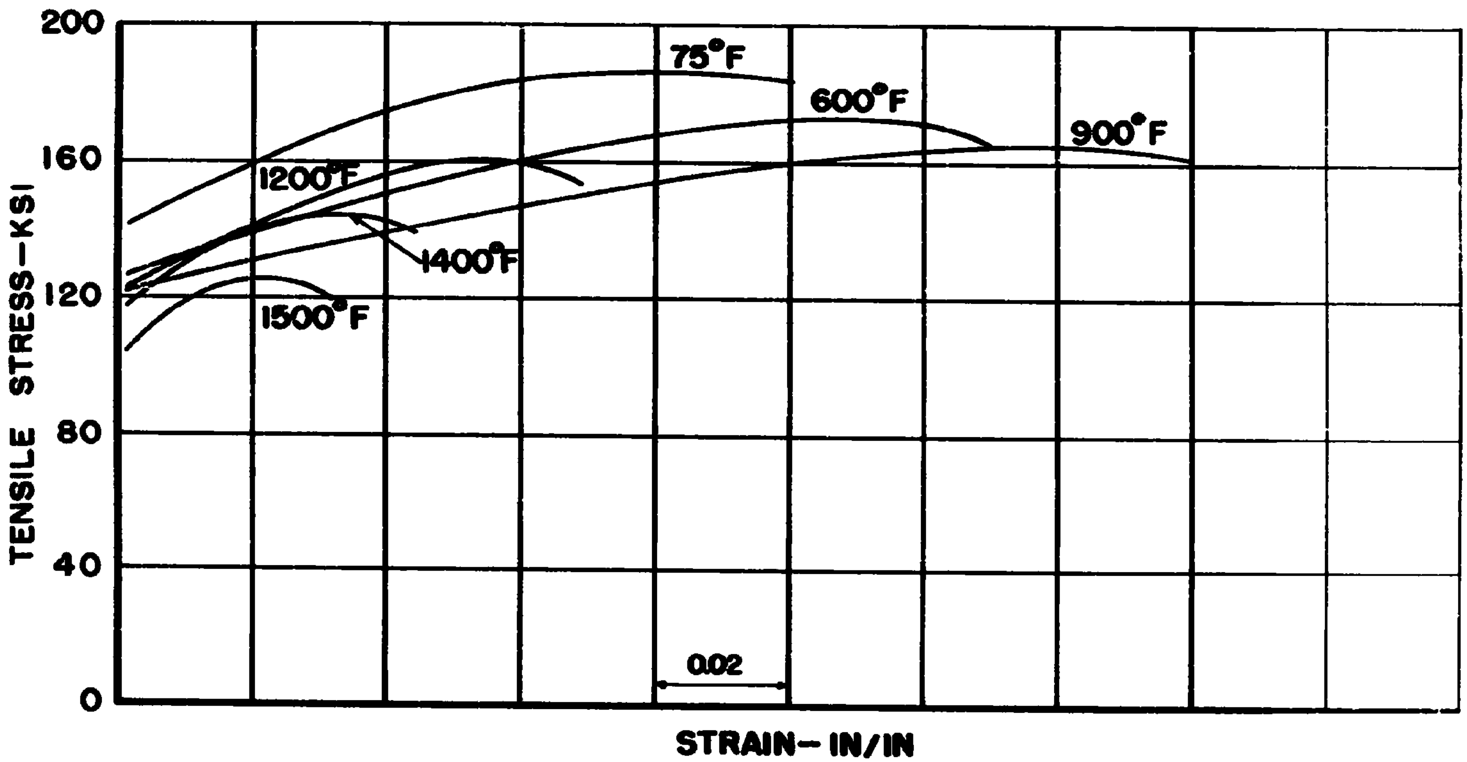


FIGURE 203. TENSILE POSTYIELD STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 0.5 HOURS

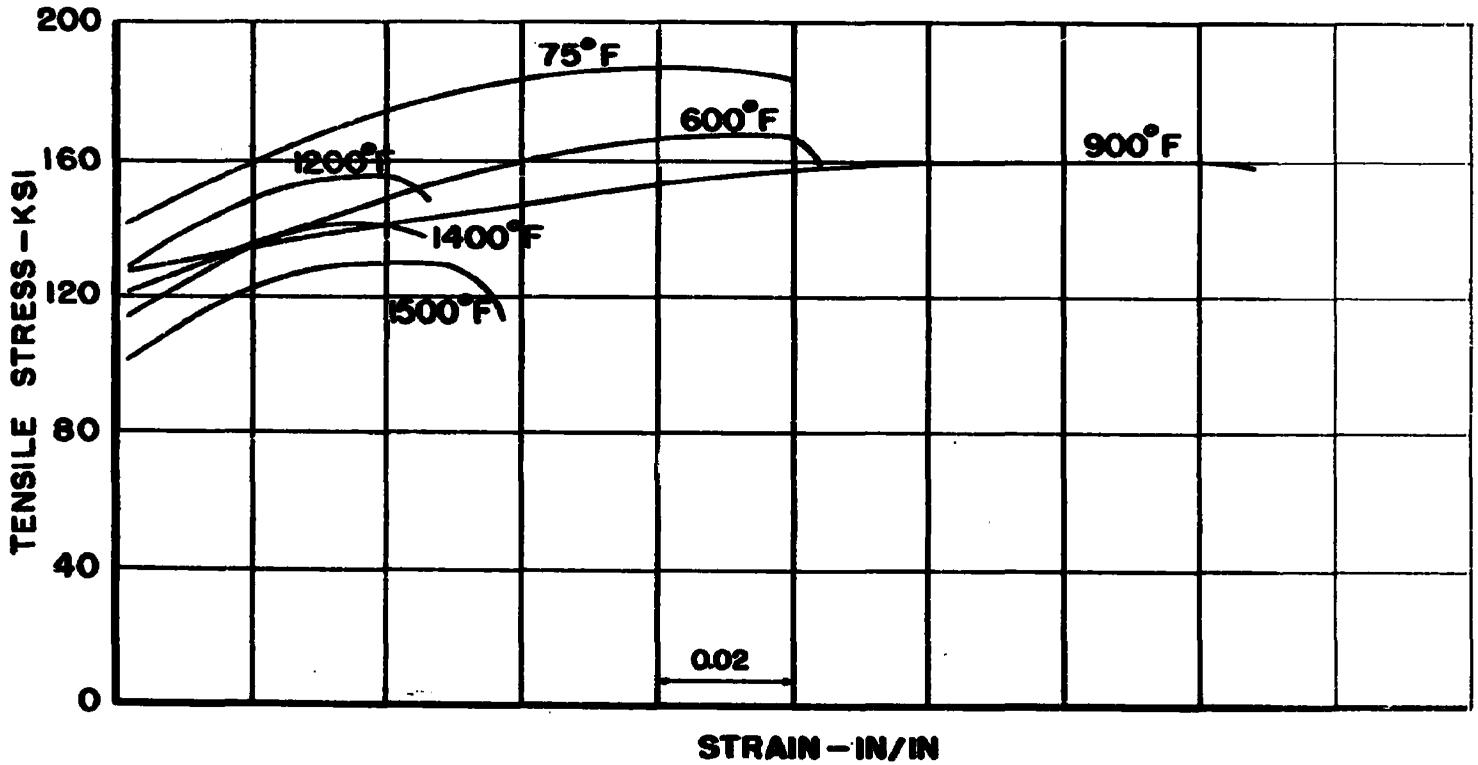


FIGURE 204. TENSILE POSTYIELD STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 10 HOURS

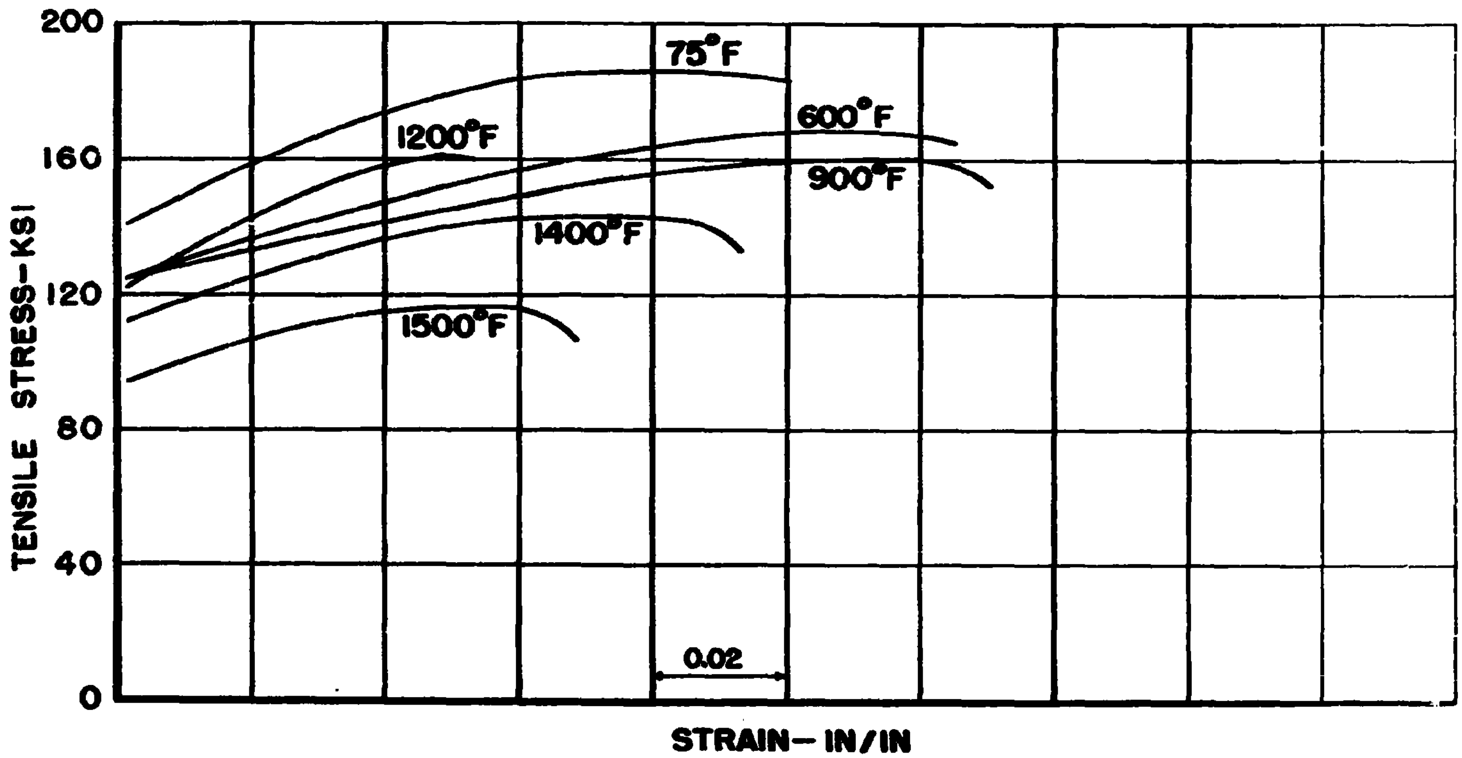


FIGURE 205. TENSILE POSTYIELD STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 100 HOURS

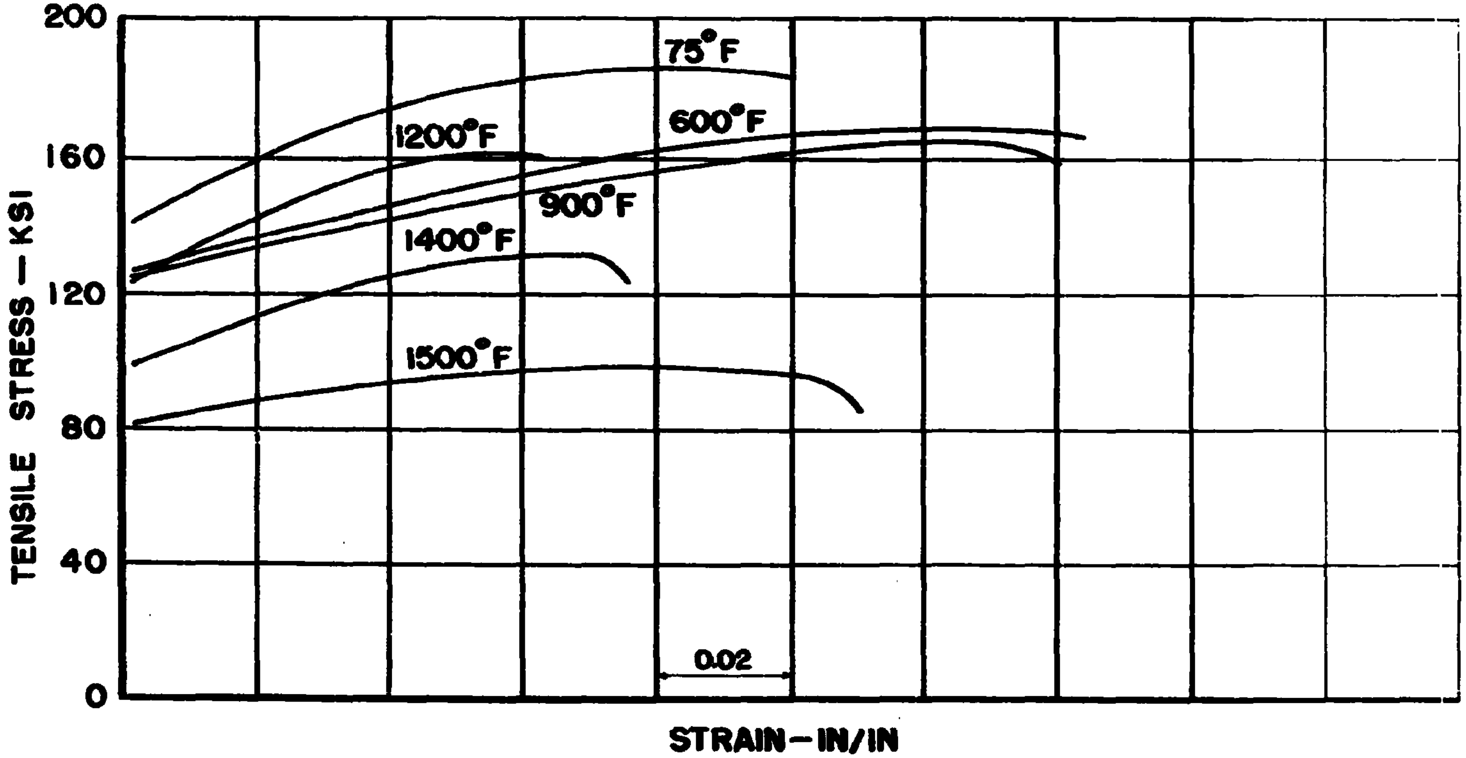


FIGURE 206. TENSILE POSTYIELD STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 1000 HOURS

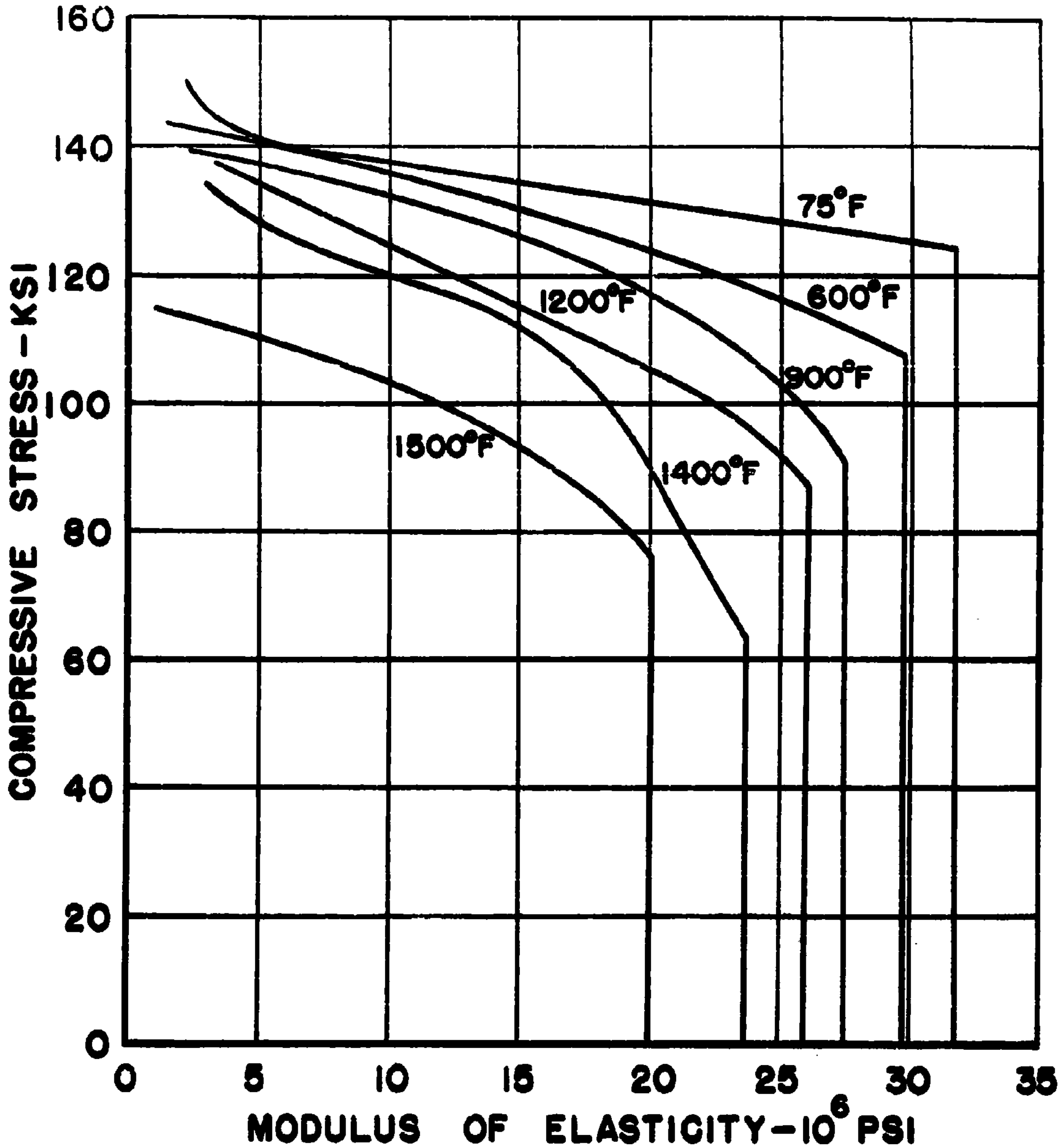


FIGURE 207. COMPRESSIVE TANGENT MODULUS CURVES OF RENÉ 41 EXPOSED 0.5 HOURS

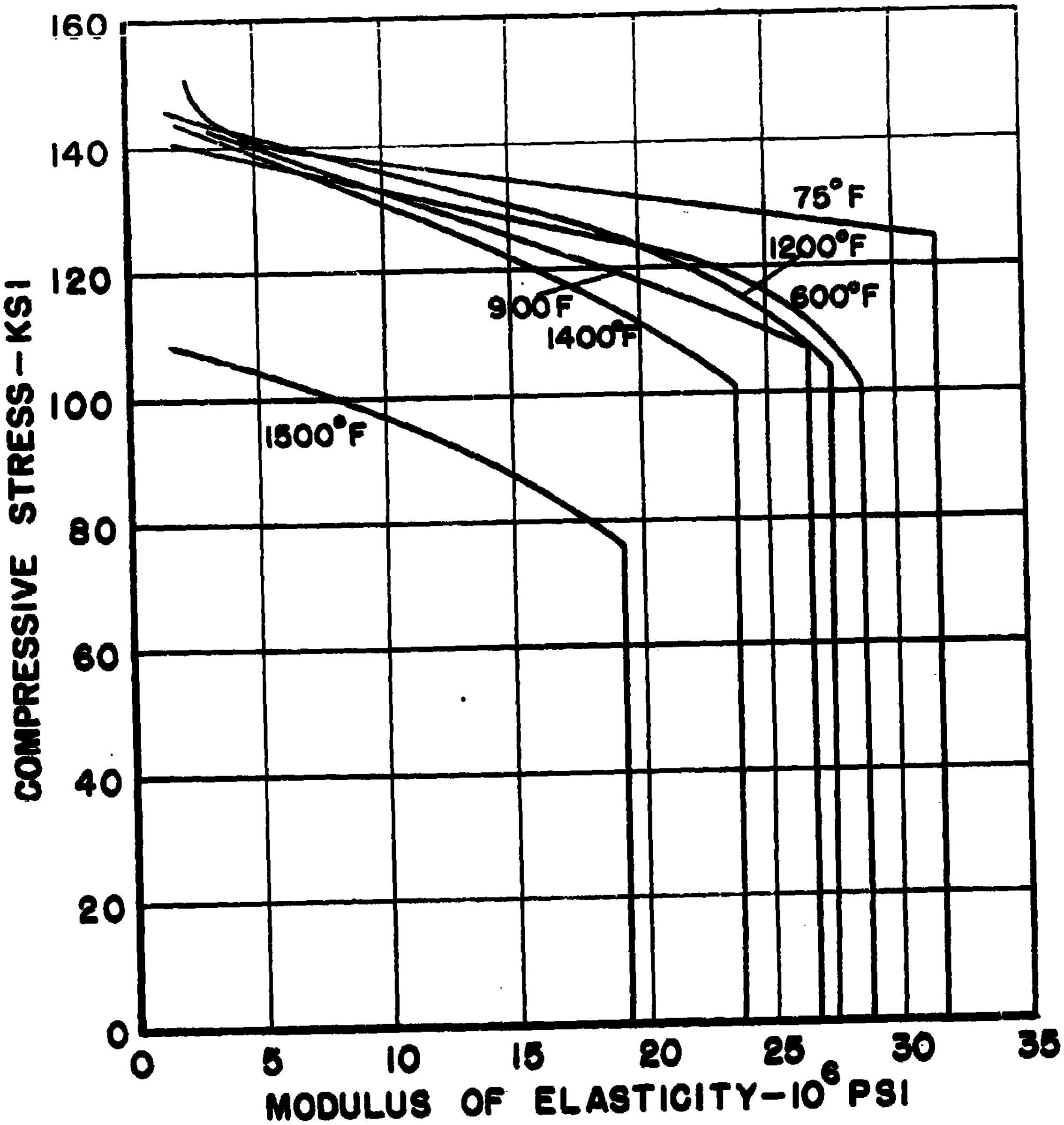


FIGURE 208. COMPRESSIVE TANGENT MODULUS CURVES OF RENÉ 41 EXPOSED 10 HOURS

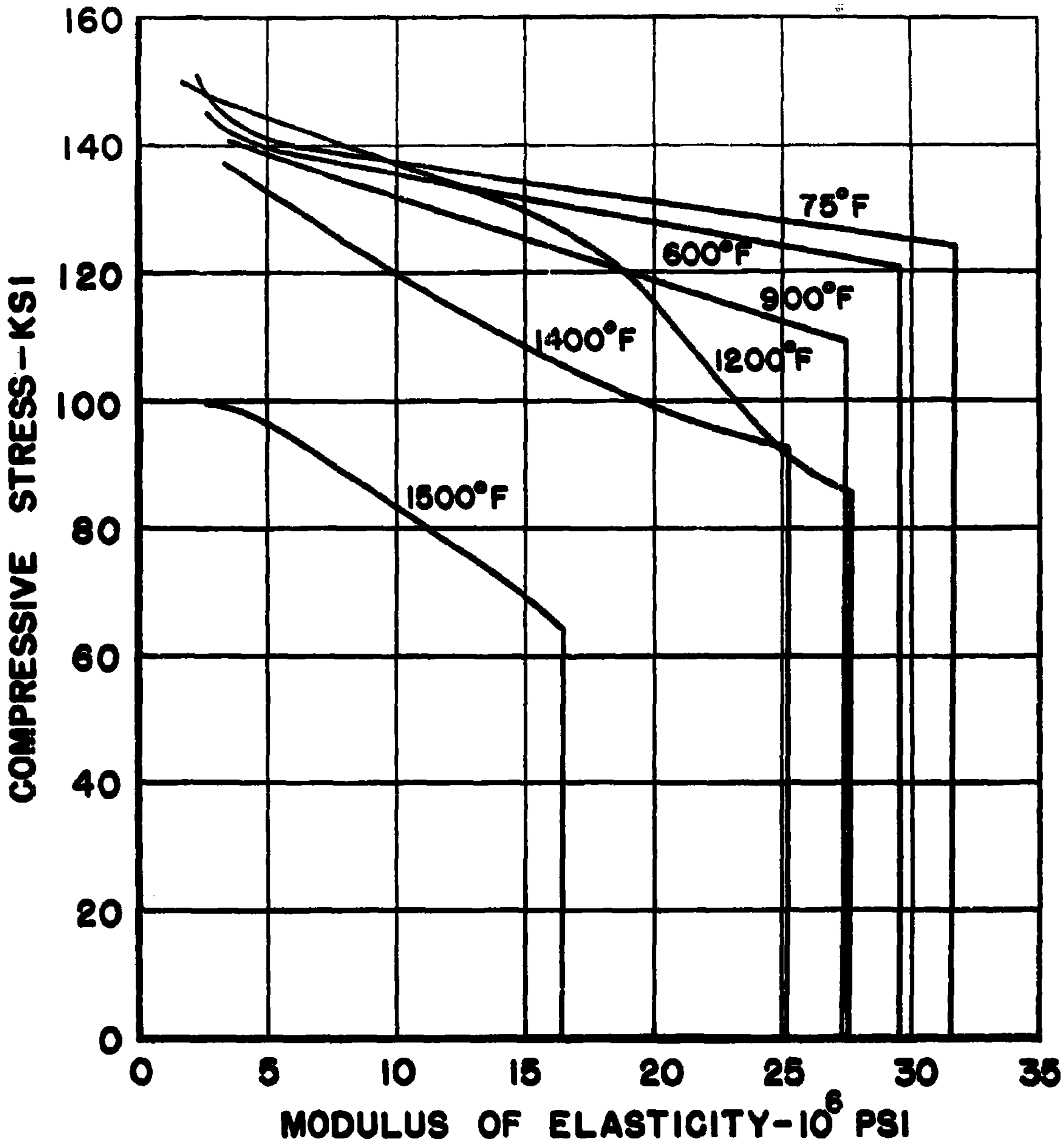


FIGURE 209. COMPRESSIVE TANGENT MODULUS CURVES OF RENÉ 41 EXPOSED 100 HOURS

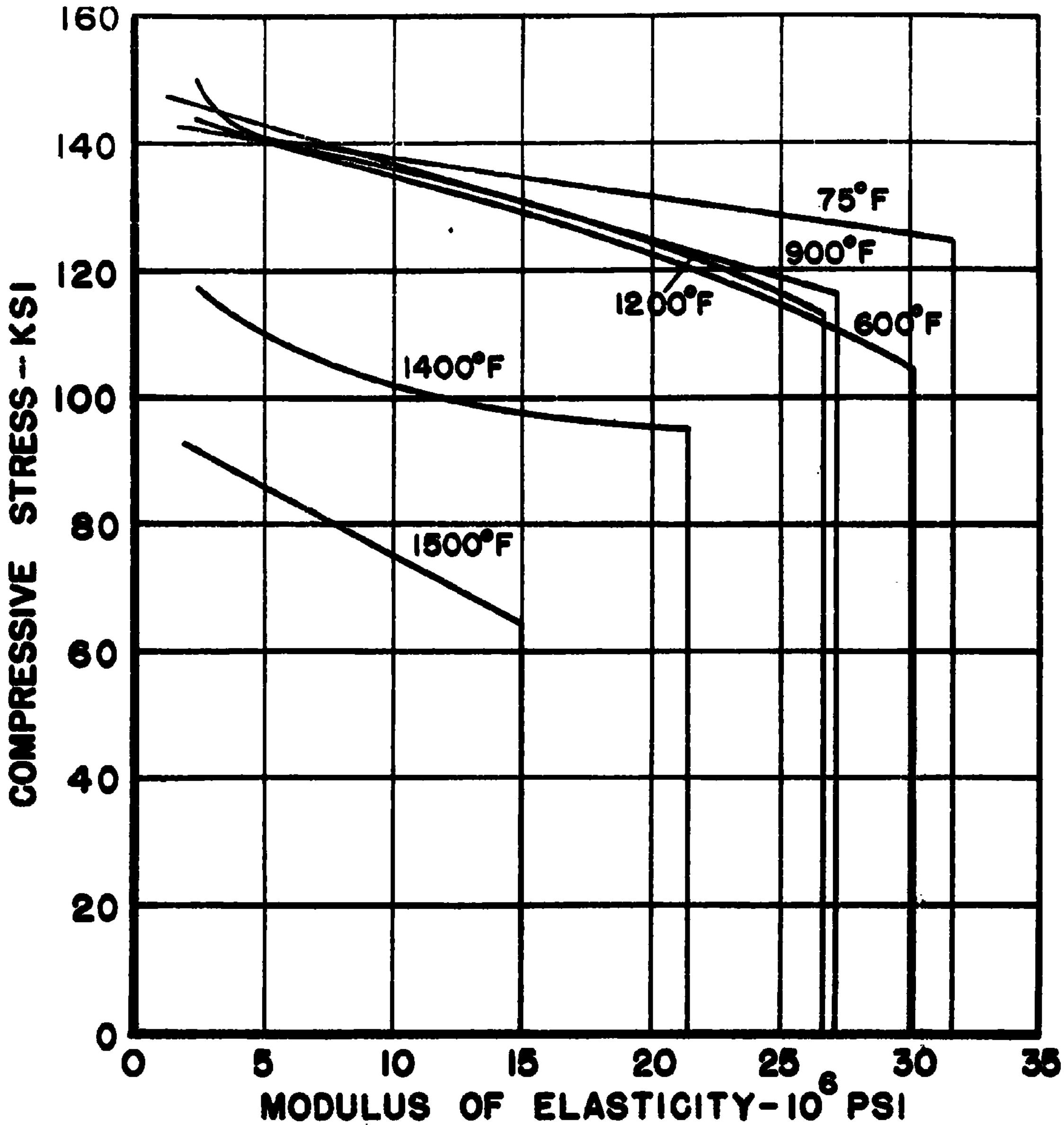


FIGURE 210. COMPRESSIVE TANGENT MODULUS CURVES OF RENÉ 41 EXPOSED 1000 HOURS

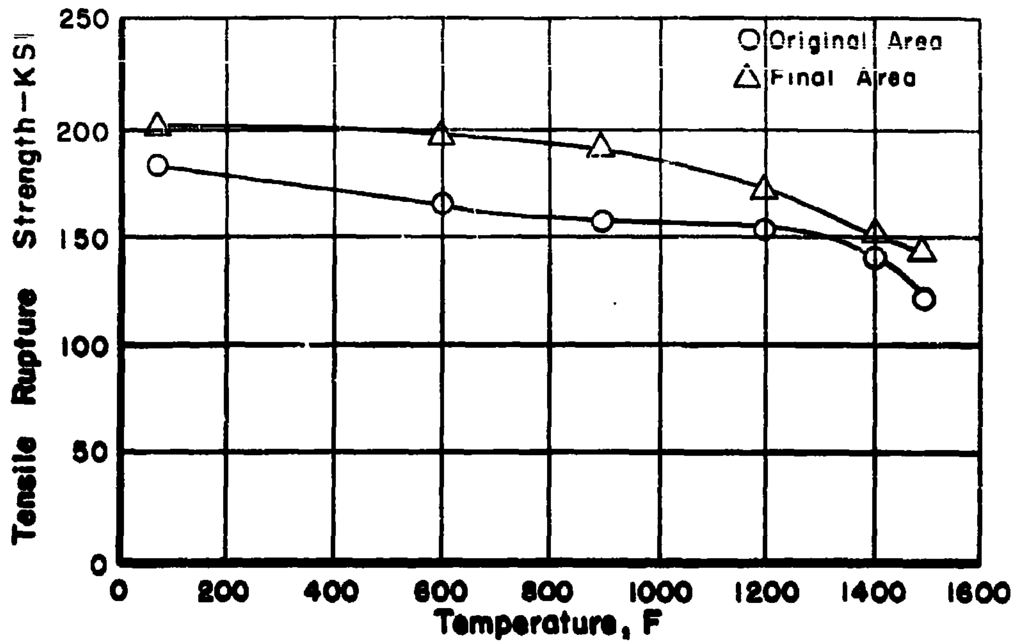


FIGURE 211. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

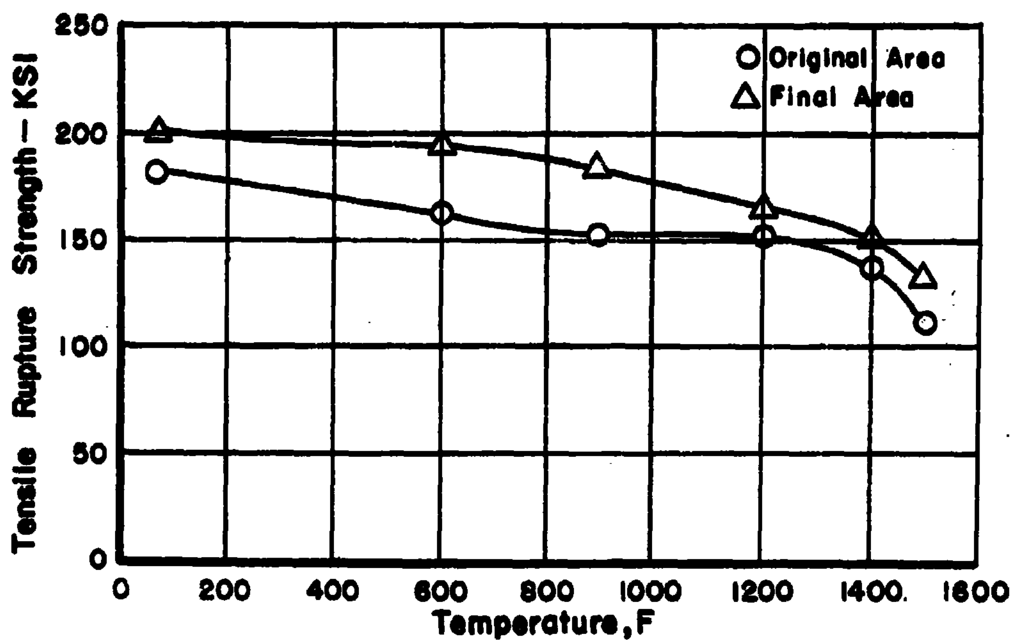


FIGURE 212. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF RENÉ 41 EXPOSED 10 HOURS, BASED C I ORIGINAL AND FINAL AREAS

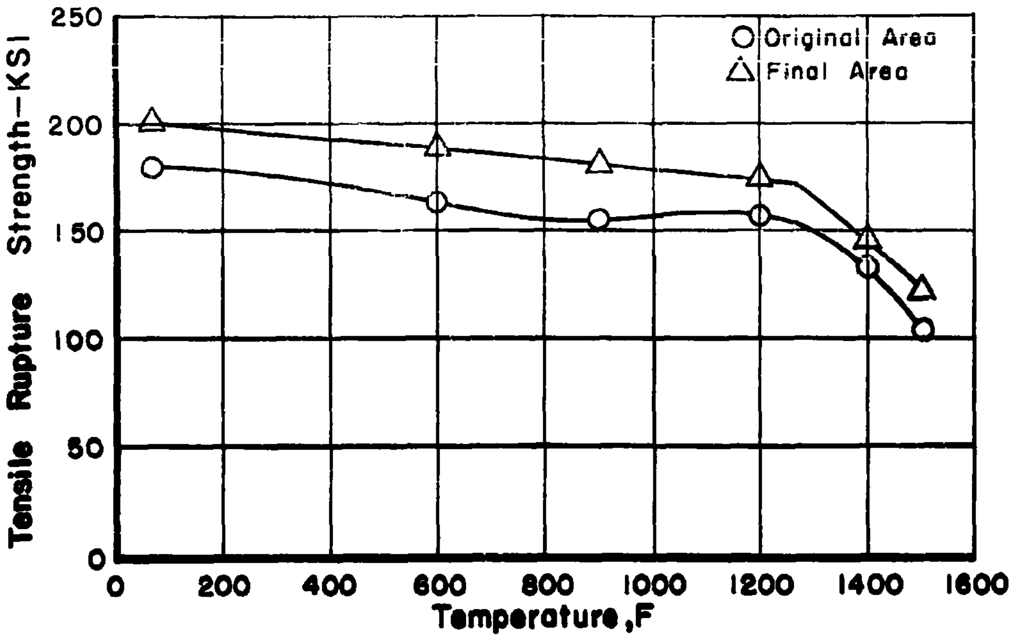


FIGURE 213. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF RENÉ 41 EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

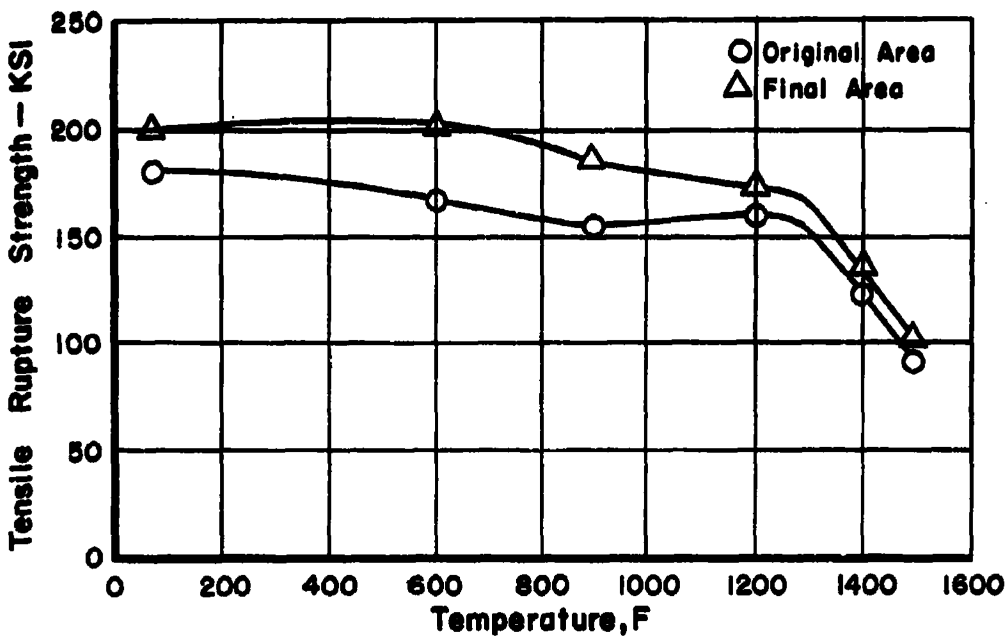


FIGURE 214. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

APPENDIX IV

## SUMMARY OF ROOM TEMPERATURE PROPERTIES OF N-155

**Form: 0.050 Inch Sheet**

**Condition: Annealed**

**Properties:**

| | | | | |
|---|---|---|---|---|
| Ultimate Tensile Strength | - | $F_{tu}$ | = | 117,100 psi |
| Tensile Yield Strength | - | $F_{ty}$ | = | 58,910 psi |
| Modulus of Elasticity | - | $E$ | = | $29.14 \times 10^6$ psi |
| Percent Elongation in 2 inches | | | = | 49.3 |
| Notched Tensile Strength | - | $F_{tu}$ | = | 110,770 psi |
| Compressive Yield Strength | - | $F_{cy}$ | = | 52,370 psi |
| Compressive Modulus of Elasticity | - | $E_c$ | = | $29.76 \times 10^6$ psi |
| Ultimate Bearing Strength | | | | |
| (e/D = 1.5) | - | $F_{bru}$ | = | 198,130 psi |
| (e/D = 2.0) | - | $F_{bru}$ | = | 259,200 psi |
| Bearing Yield Strength | | | | |
| (e/D = 1.5) | - | $F_{bry}$ | = | 89,070 psi |
| (e/D = 2.0) | - | $F_{bry}$ | = | 116,800 psi |
| Ultimate Shear Strength | - | $F_{su}$ | = | 84,010 psi |

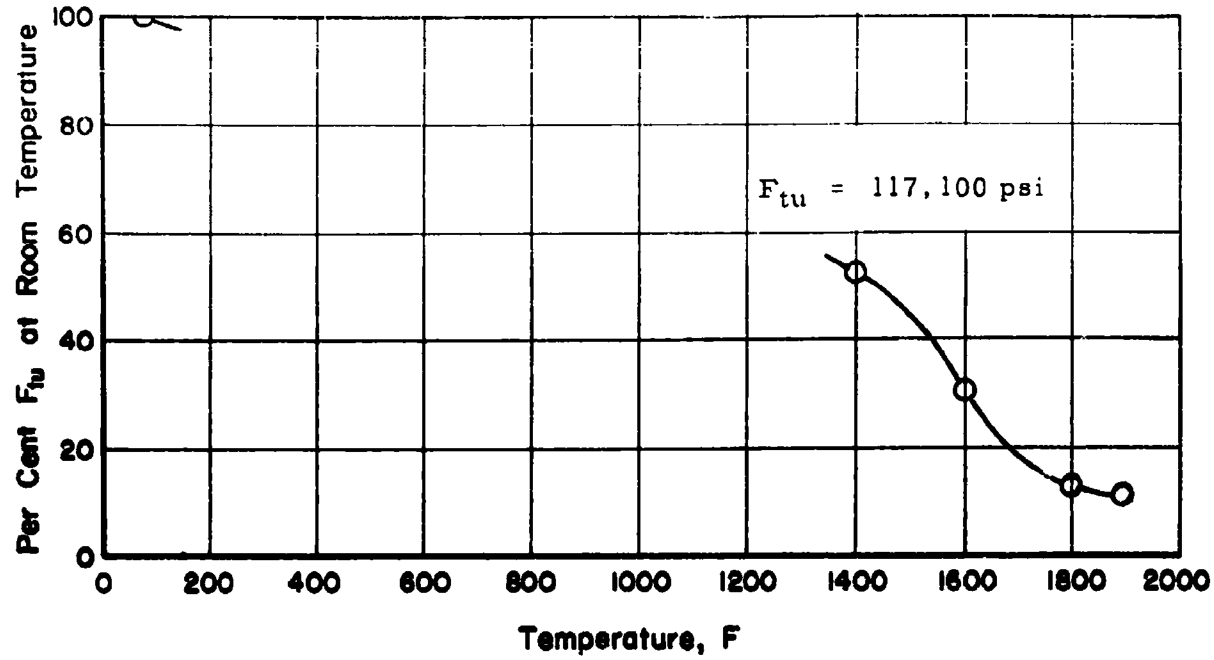


FIGURE 215. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 0.5 HOURS

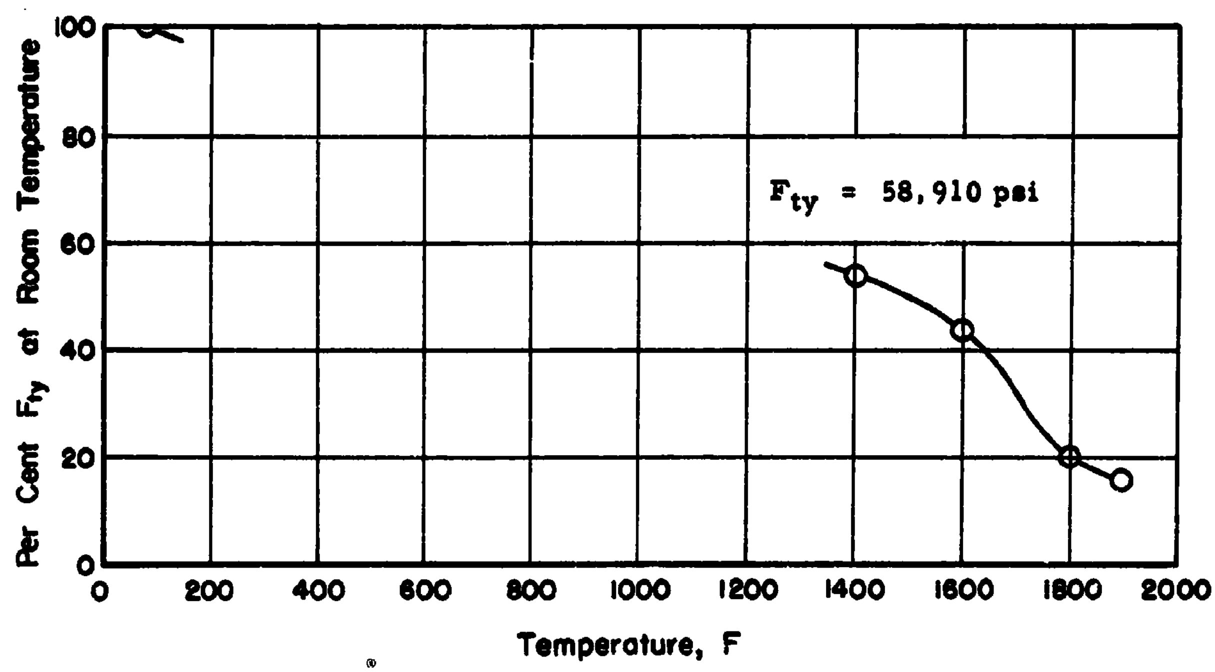


FIGURE 216. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF N-155 EXPOSED 0.5 HOURS

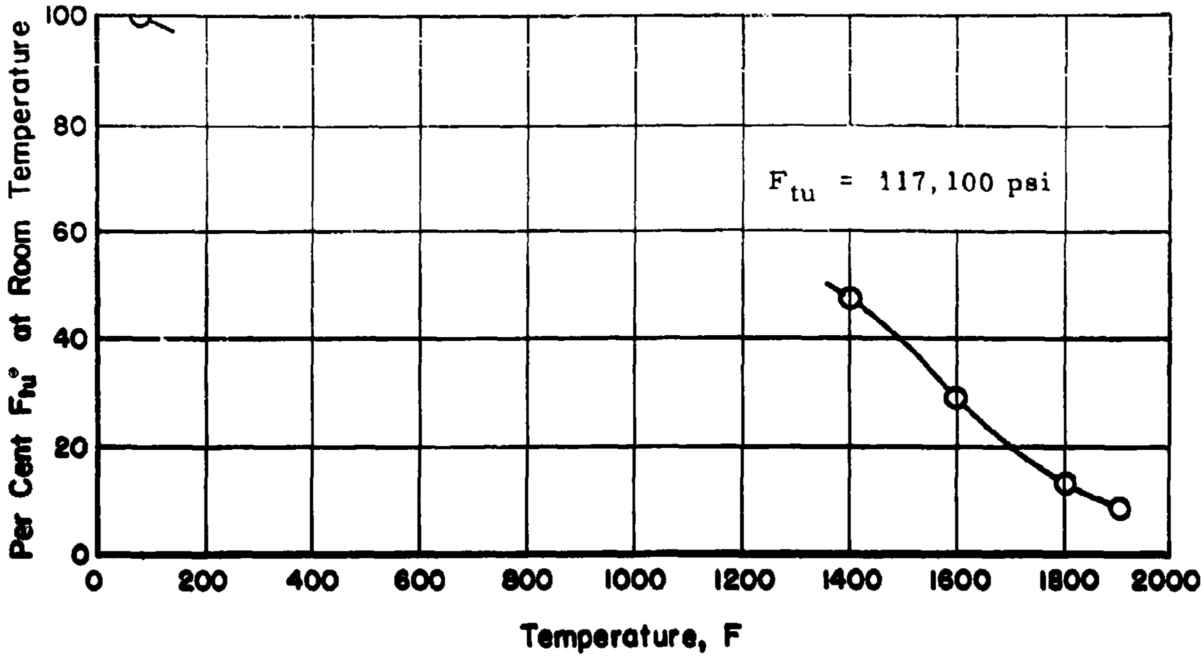


FIGURE 217. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 10 HOURS

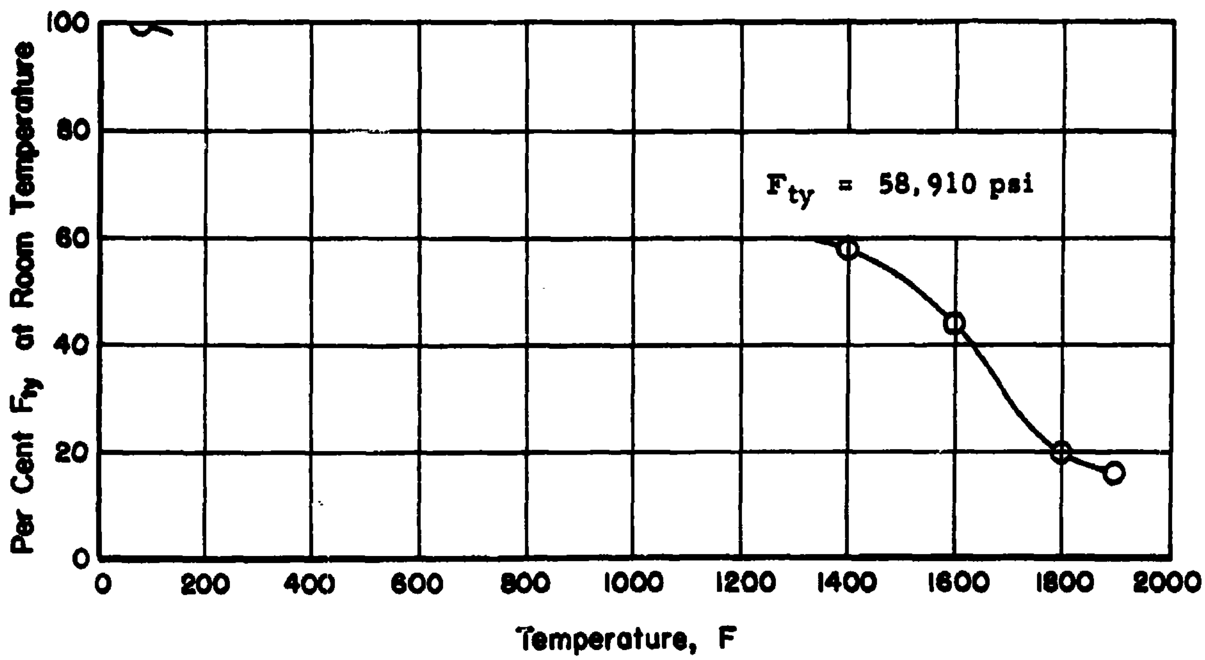


FIGURE 218. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF N-155 EXPOSED 10 HOURS

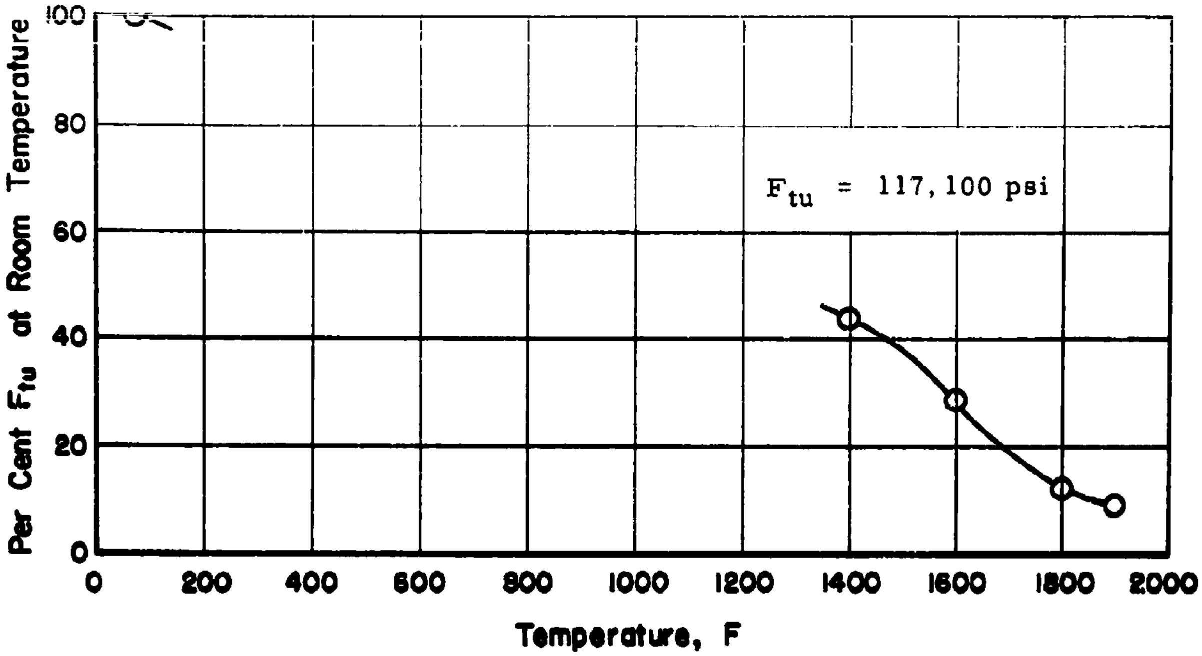


FIGURE 219. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 100 HOURS

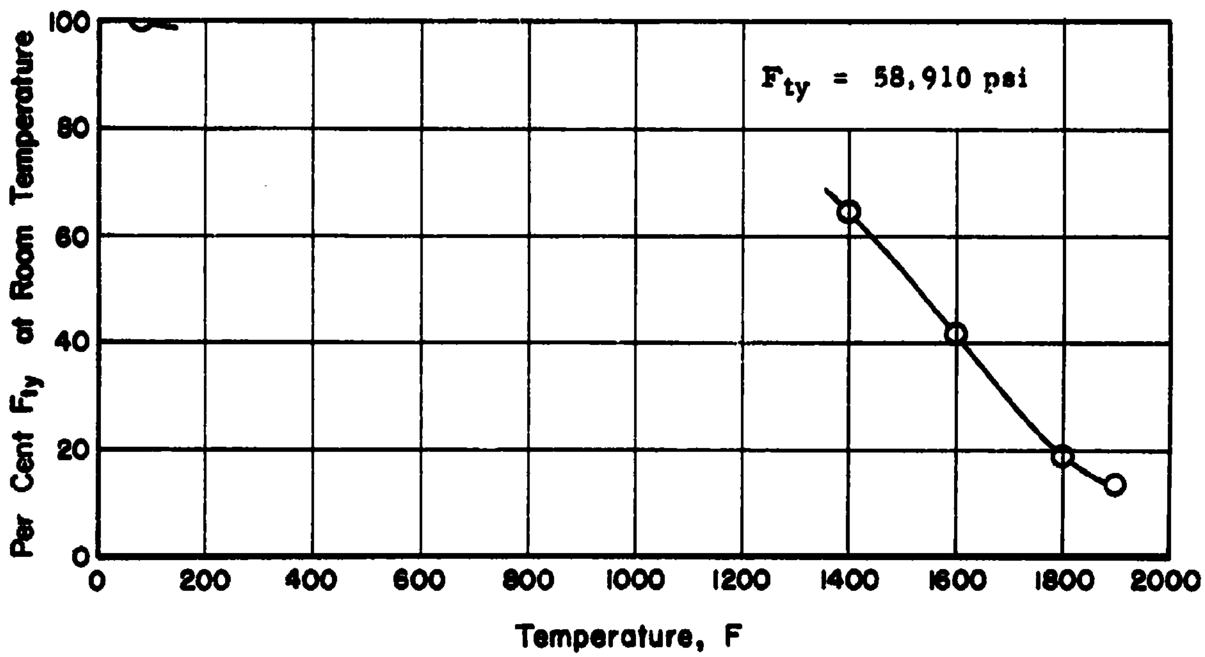


FIGURE 220. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF N-155 EXPOSED 100 HOURS

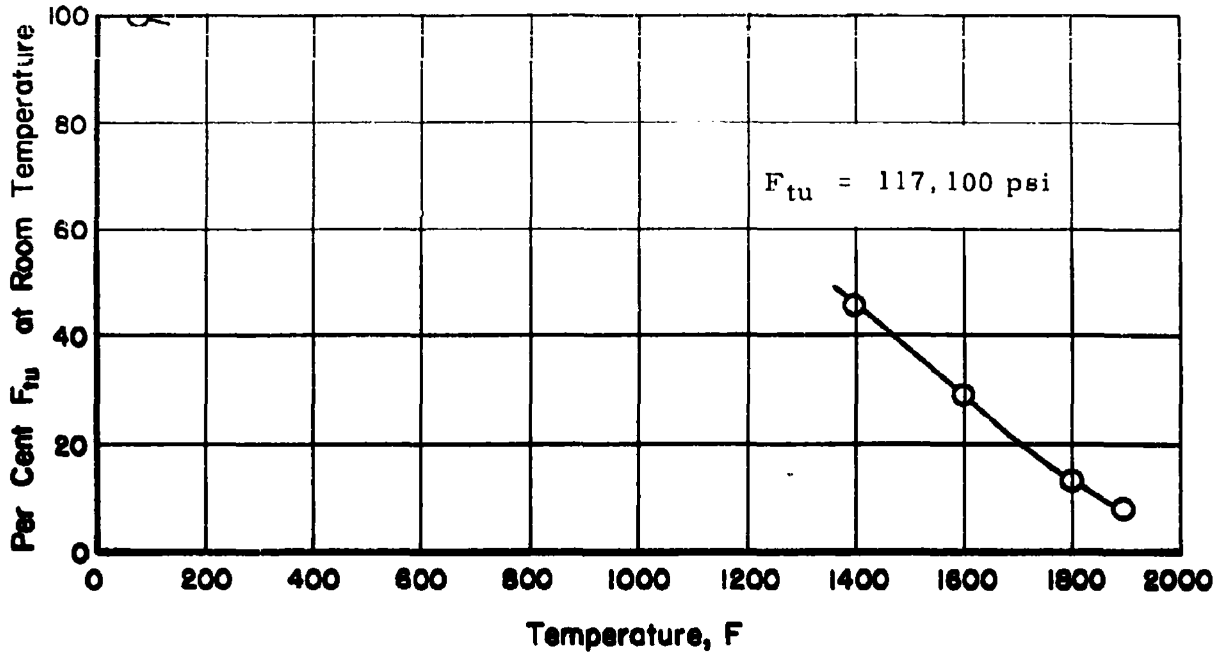


FIGURE 221. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 1000 HOURS

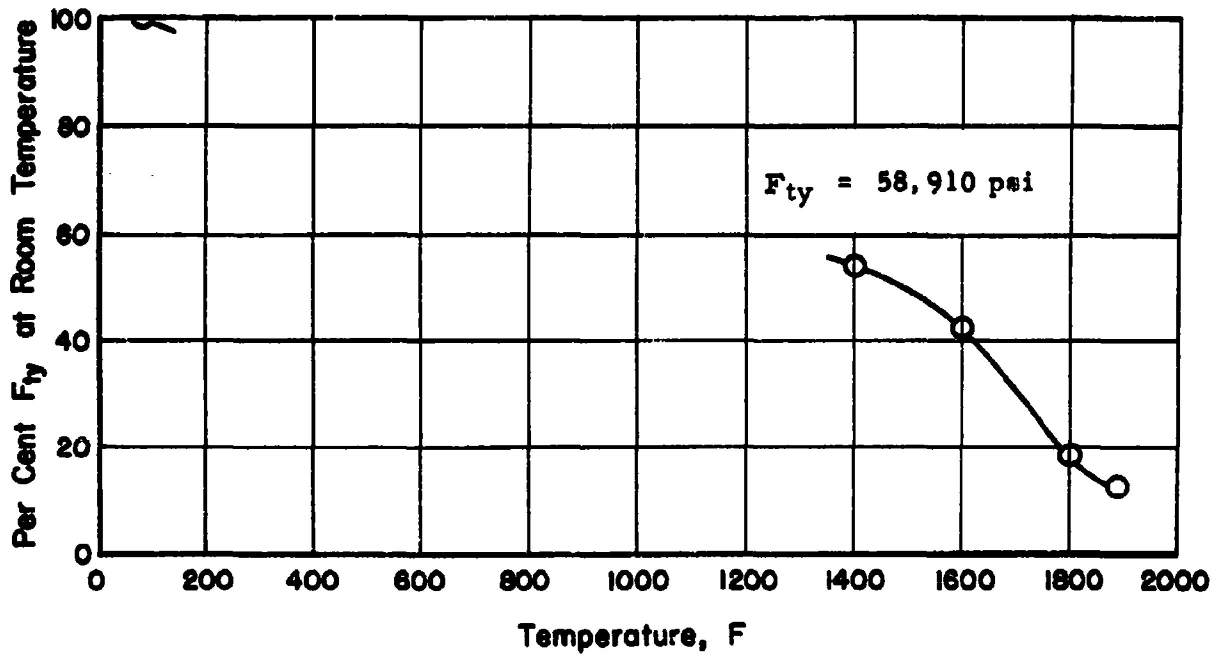


FIGURE 222. EFFECT OF TEMPERATURE ON ULTIMATE YIELD STRENGTH OF N-155 EXPOSED 1000 HOURS

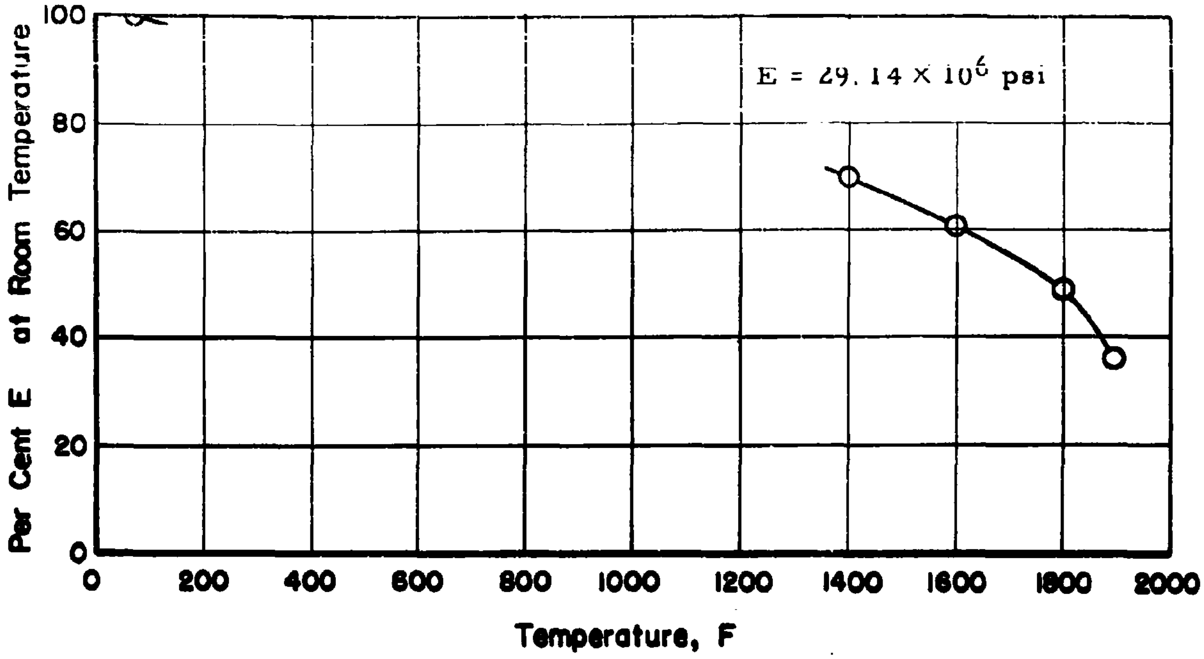


FIGURE 223. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF N-155 EXPOSED 0.5 HOURS

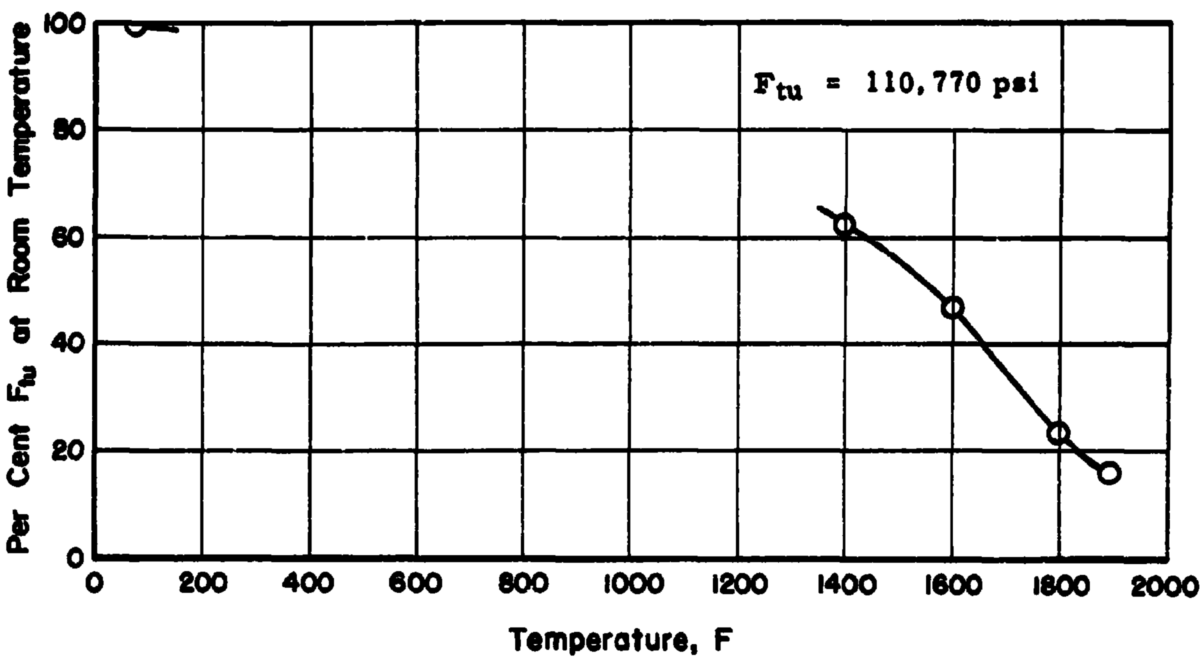


FIGURE 224. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 0.5 HOURS

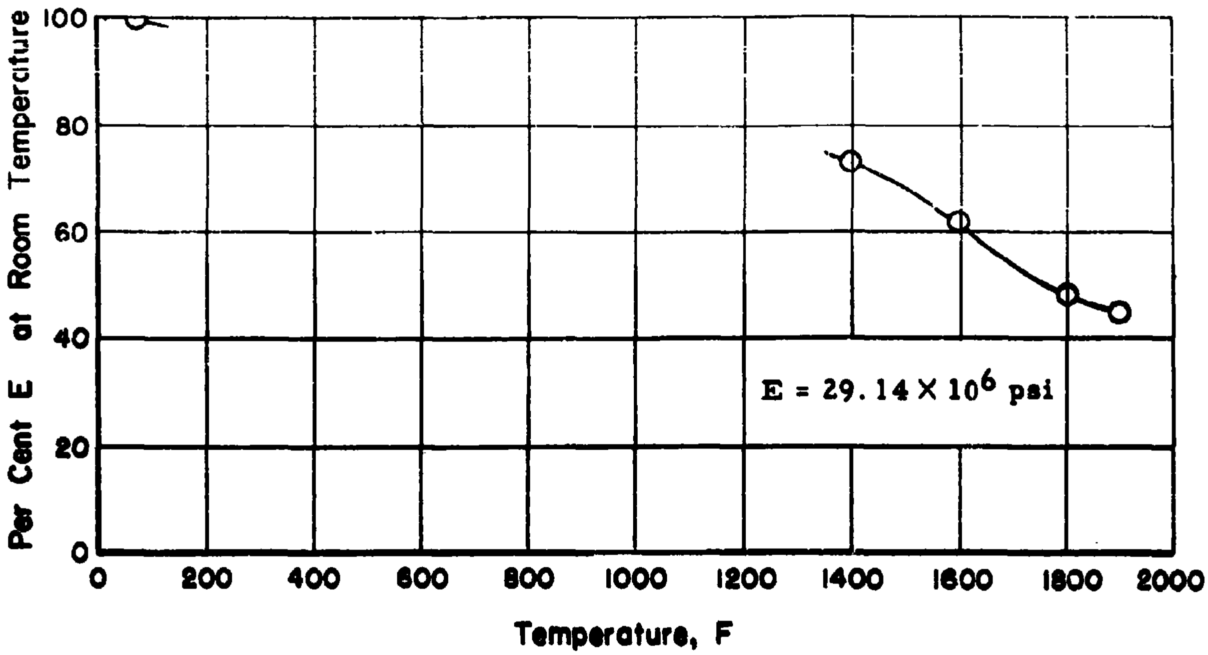


FIGURE 225. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF N-155 EXPOSED 10 HOURS

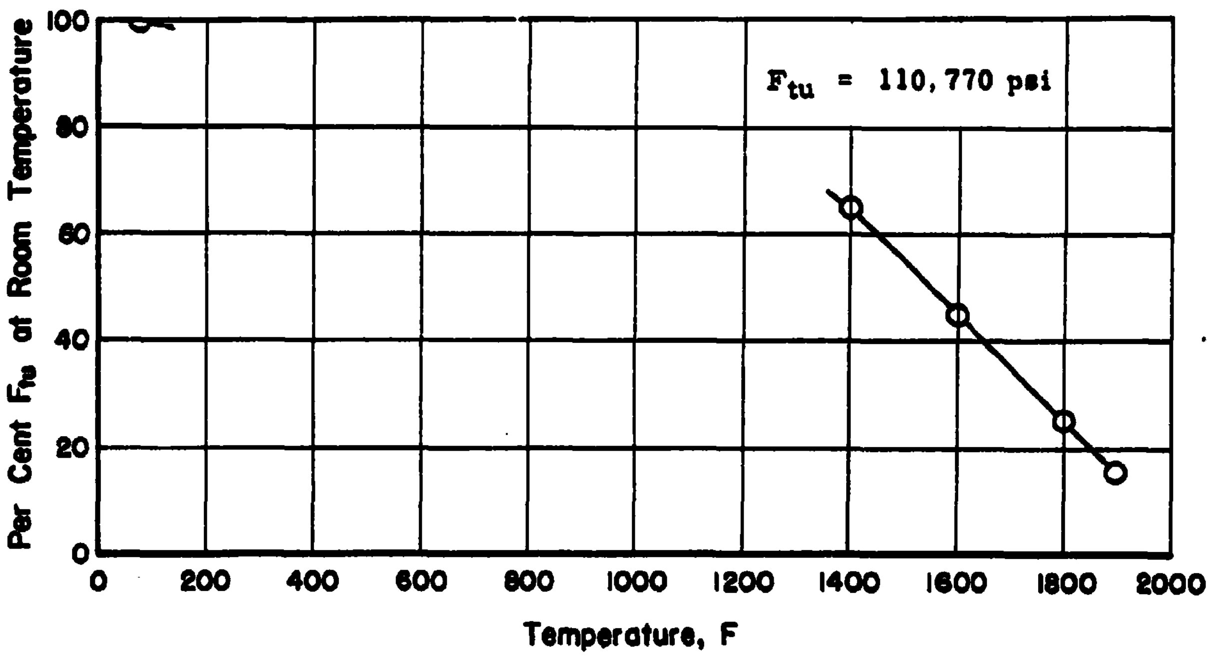


FIGURE 226. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 10 HOURS

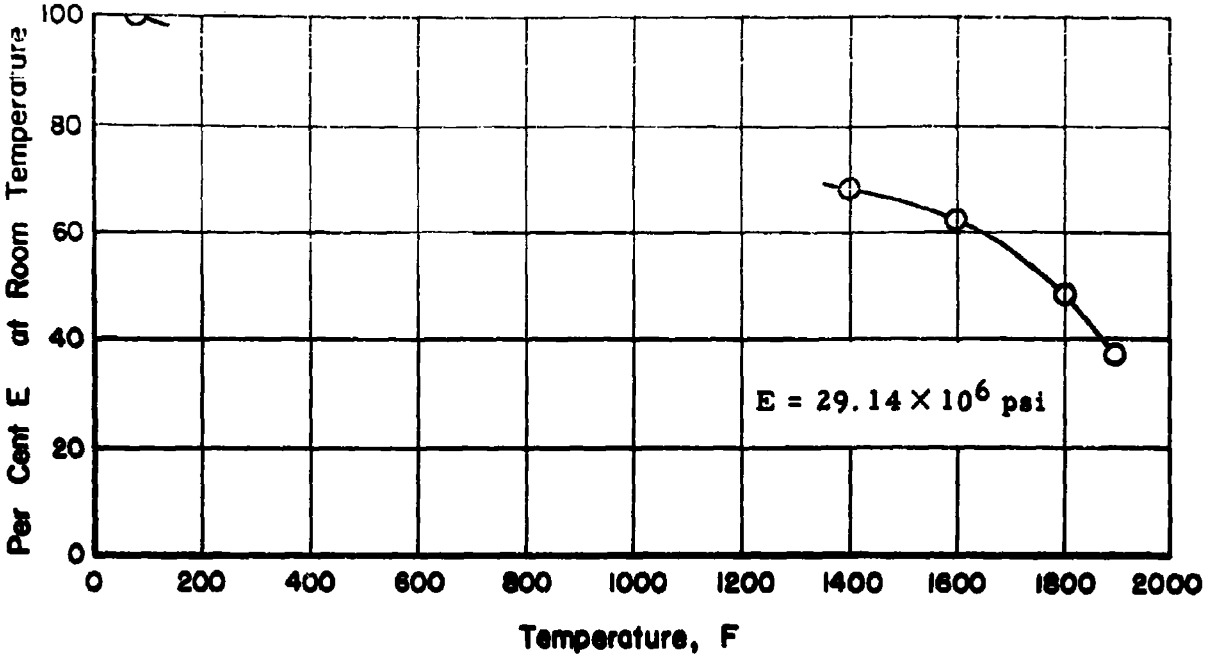


FIGURE 227. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF N-155 EXPOSED 100 HOURS

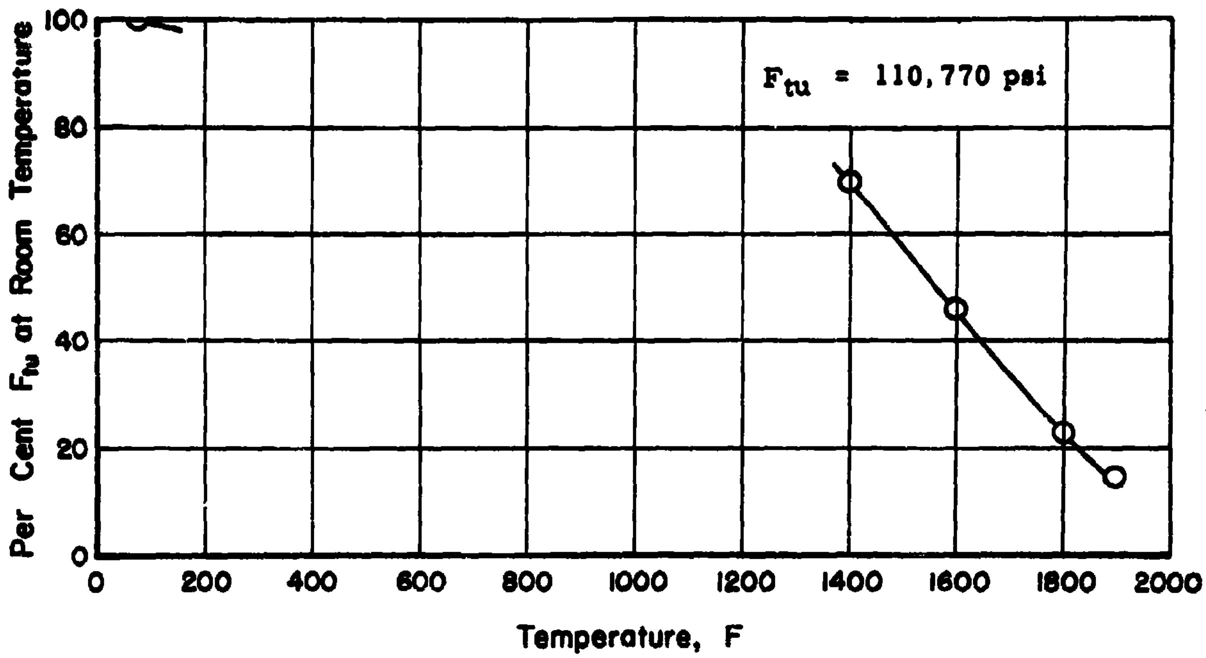


FIGURE 228. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 100 HOURS

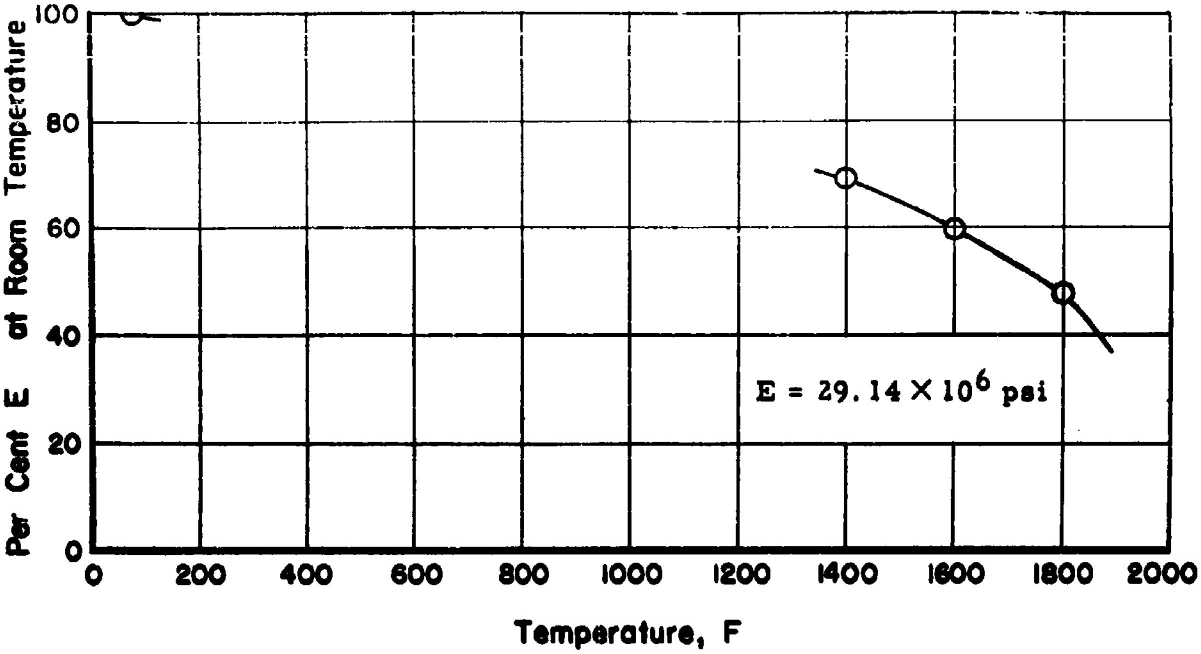


FIGURE 229. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF N-155 EXPOSED 1000 HOURS

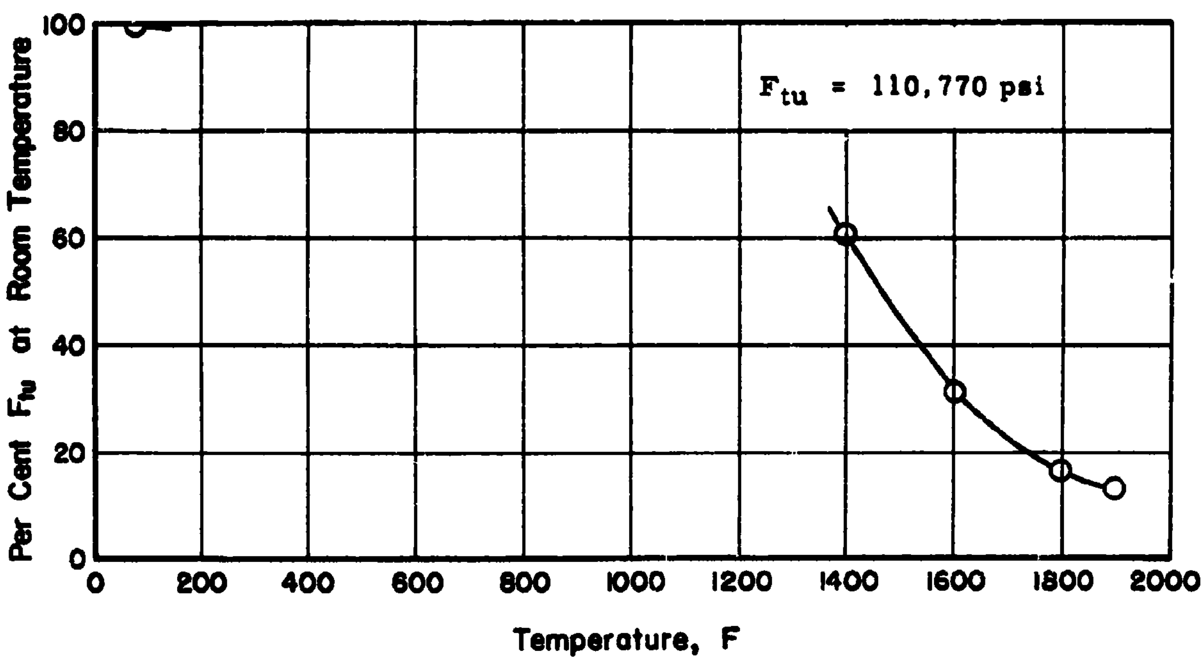


FIGURE 230. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 1000 HOURS

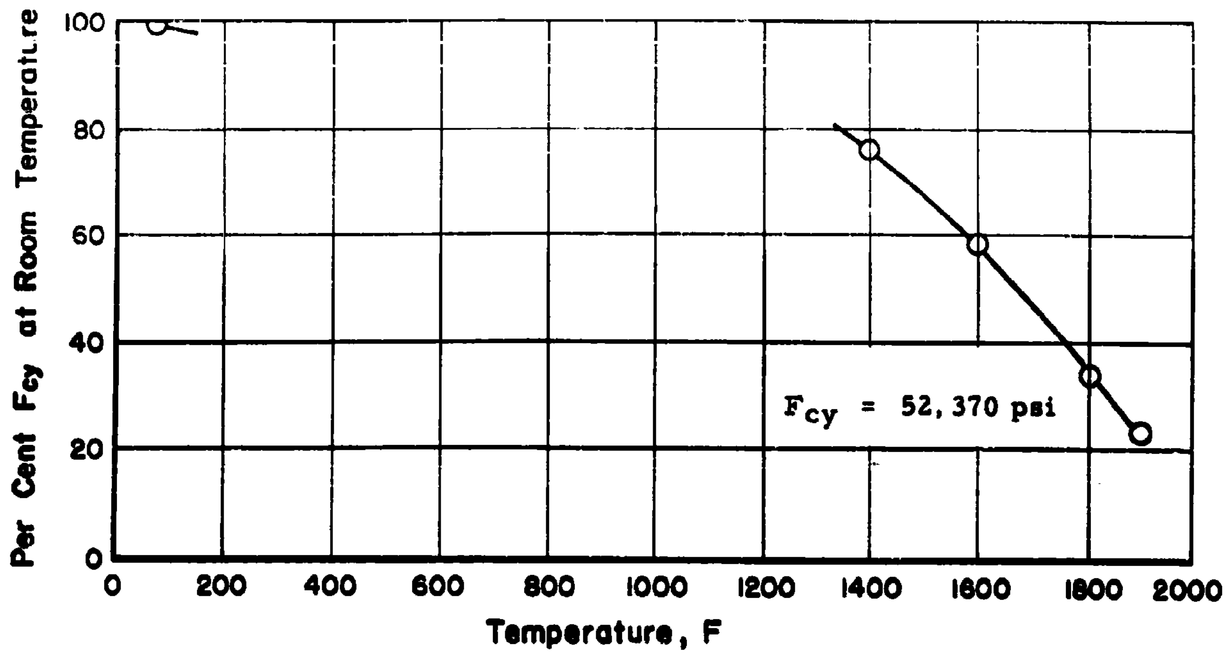


FIGURE 231. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF N-155 EXPOSED 0.5 HOURS

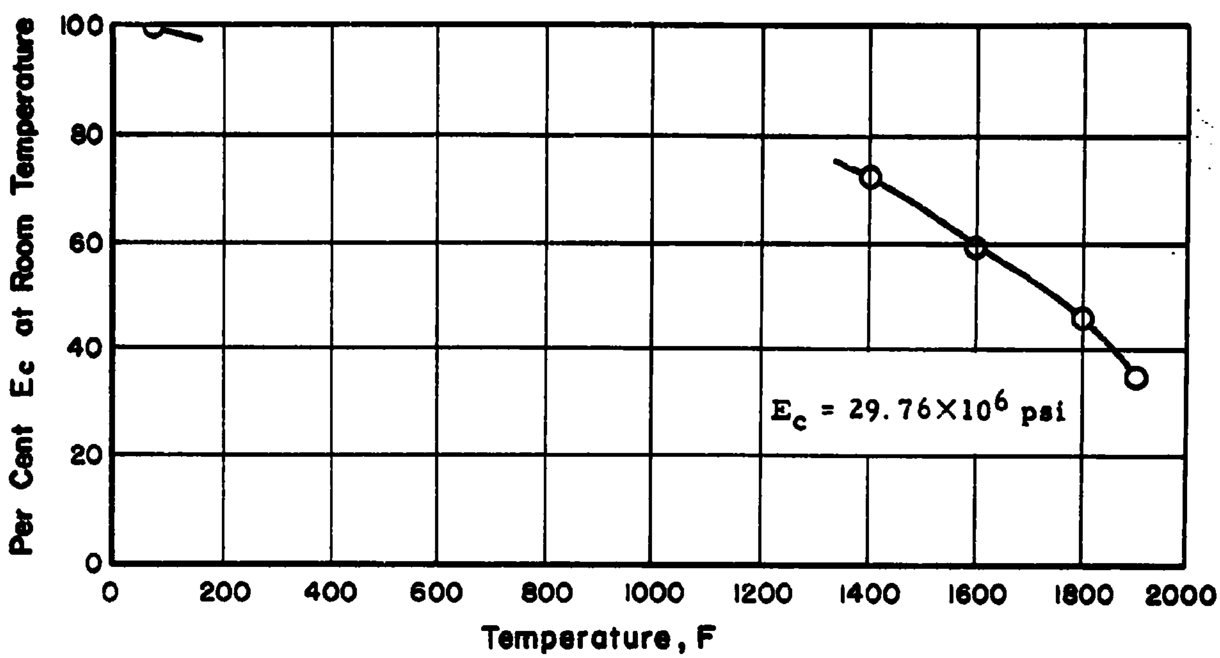


FIGURE 232. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF N-155 EXPOSED 0.5 HOURS

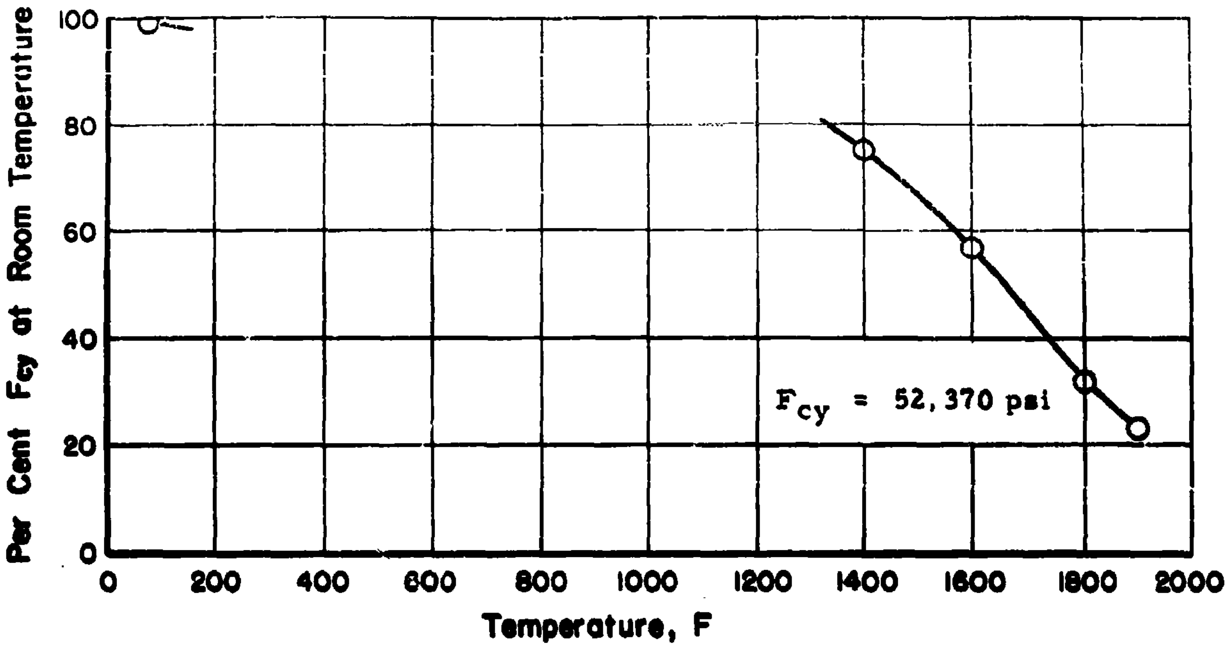


FIGURE 233. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF N-155 EXPOSED 10 HOURS

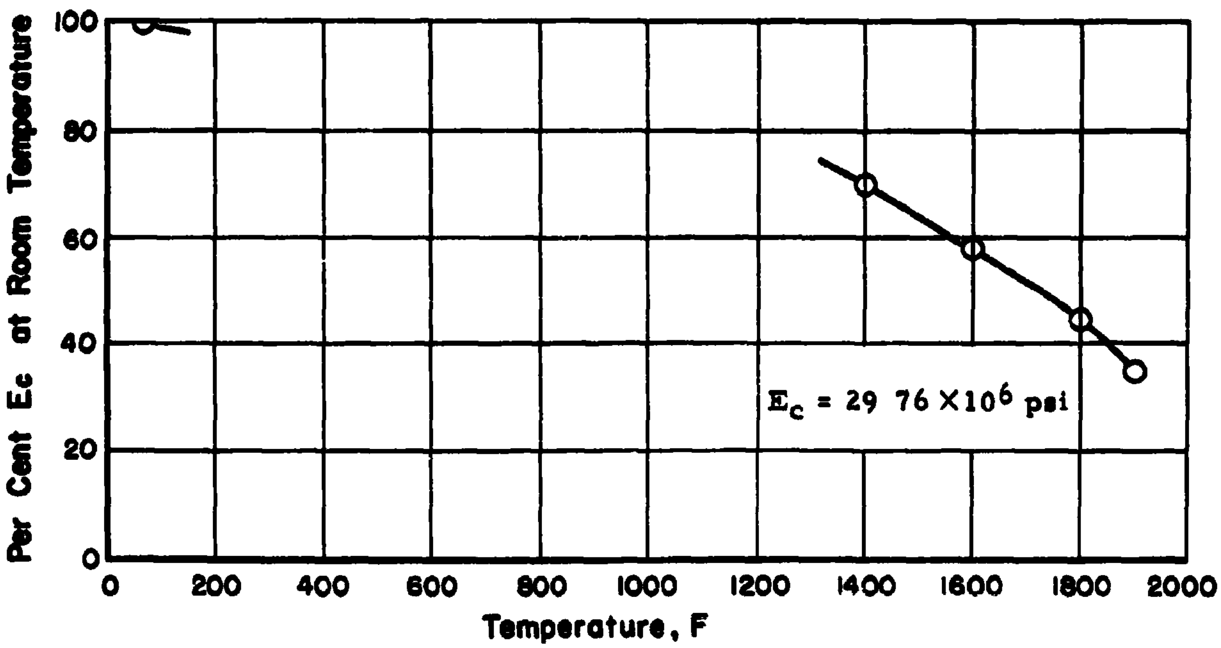


FIGURE 234. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF N-155 EXPOSED 10 HOURS

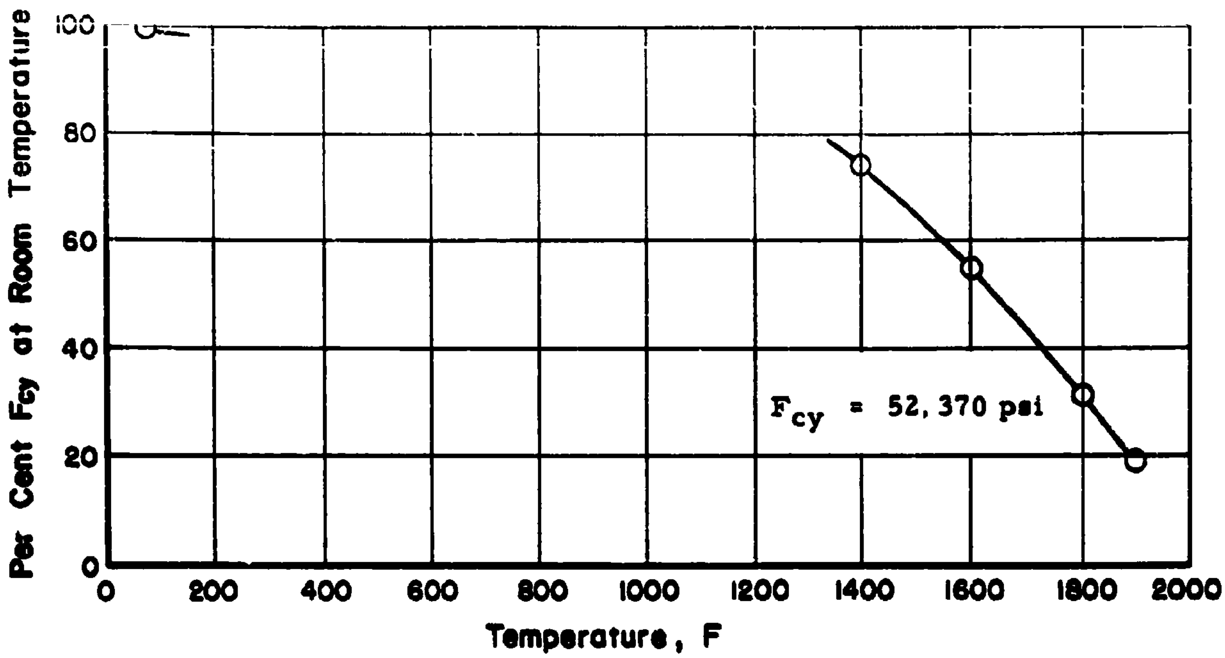


FIGURE 235. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF N-155 EXPOSED 100 HOURS

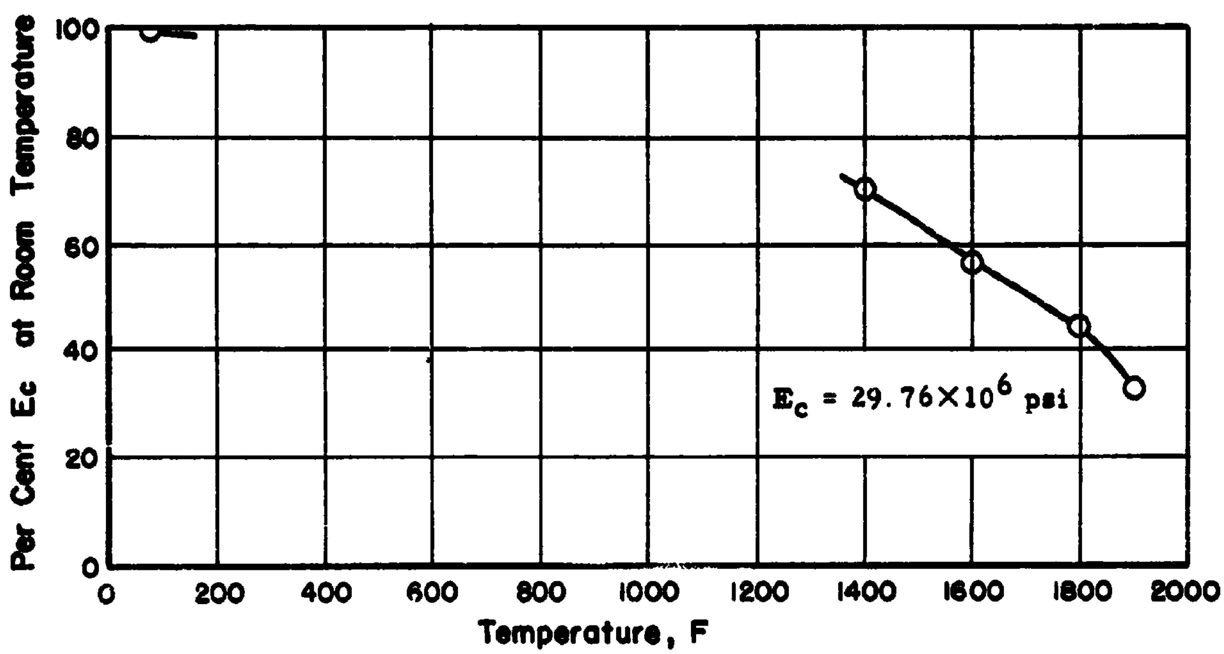


FIGURE 236. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF N-155 EXPOSED 100 HOURS

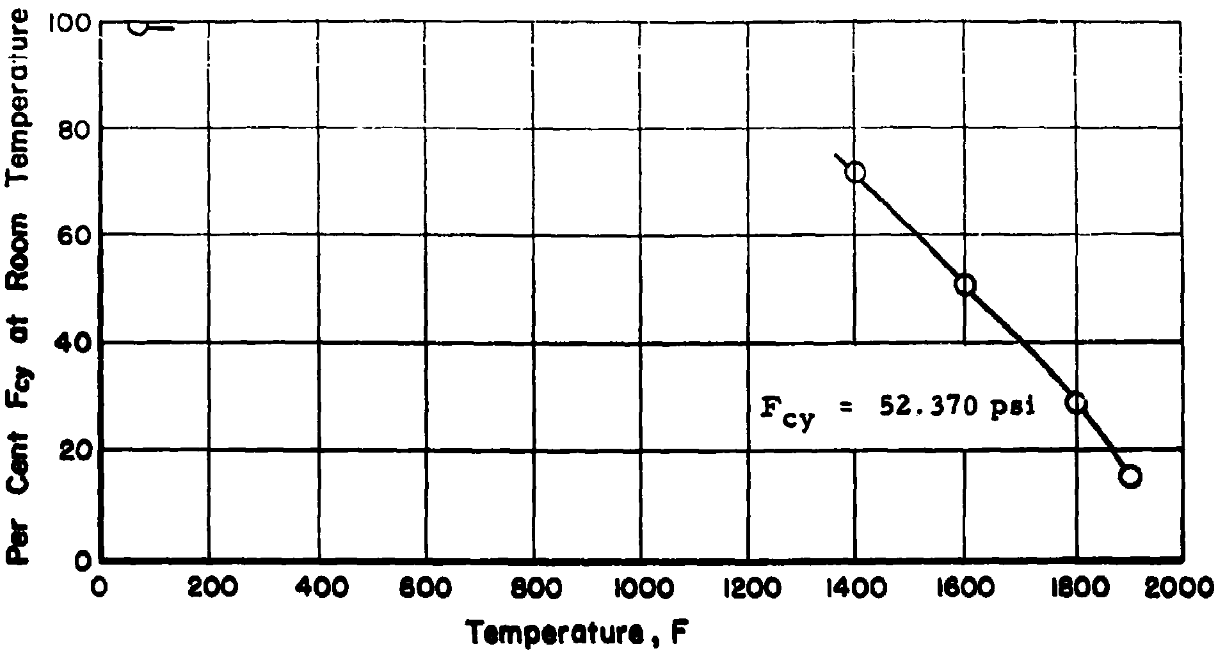


FIGURE 237. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF N-155 EXPOSED 1000 HOURS

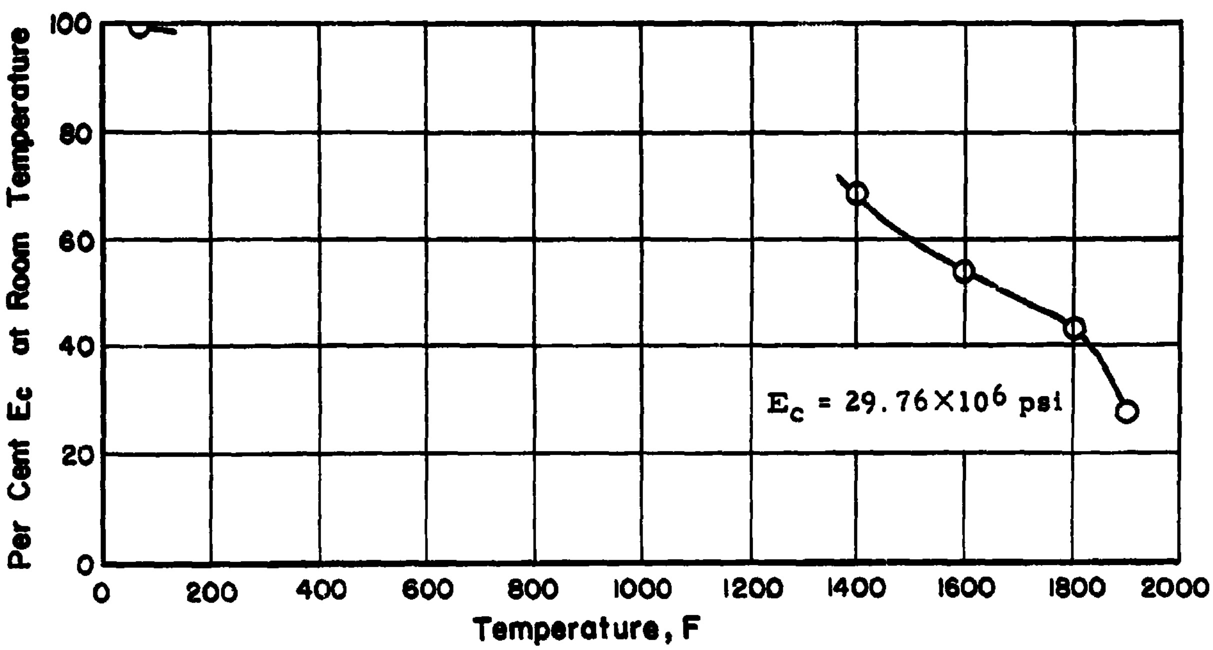


FIGURE 238. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF N-155 EXPOSED 1000 HOURS

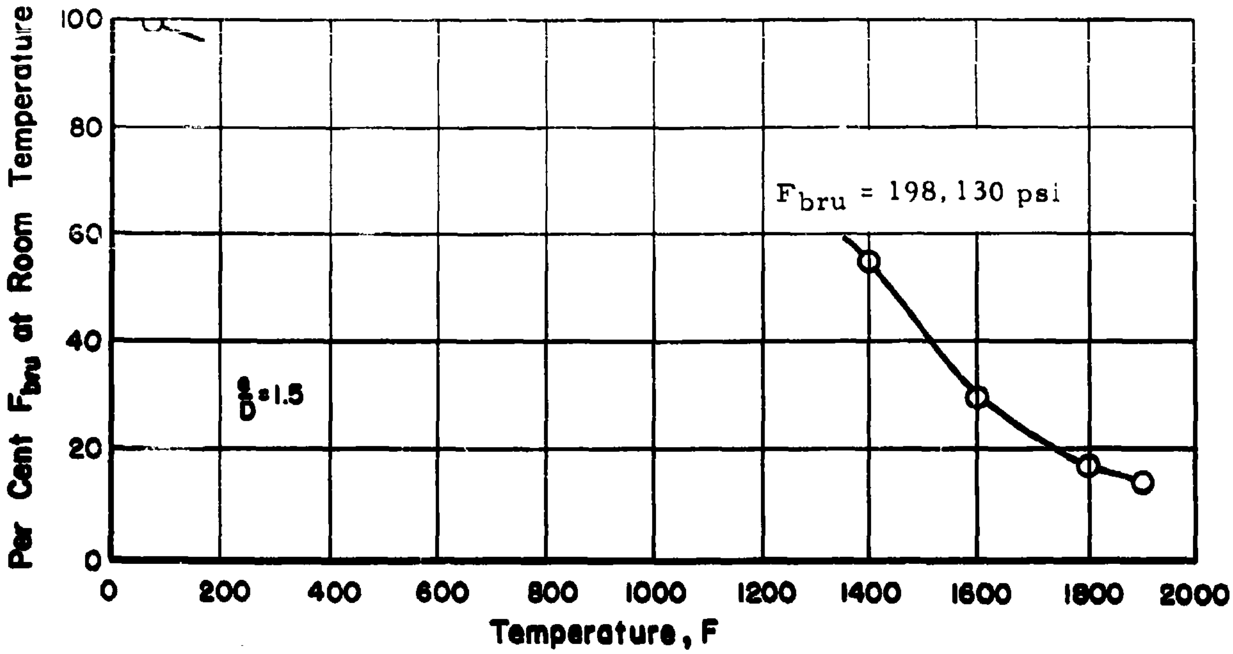


FIGURE 239. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 0.5 HOURS

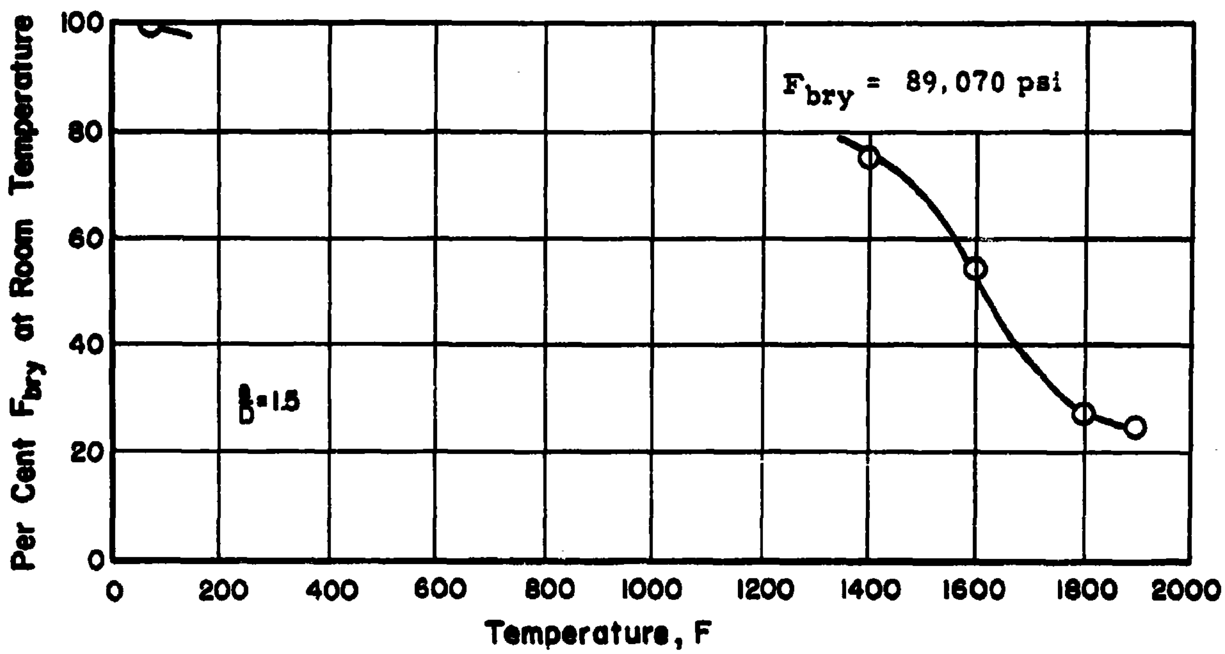


FIGURE 240. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 0.5 HOURS

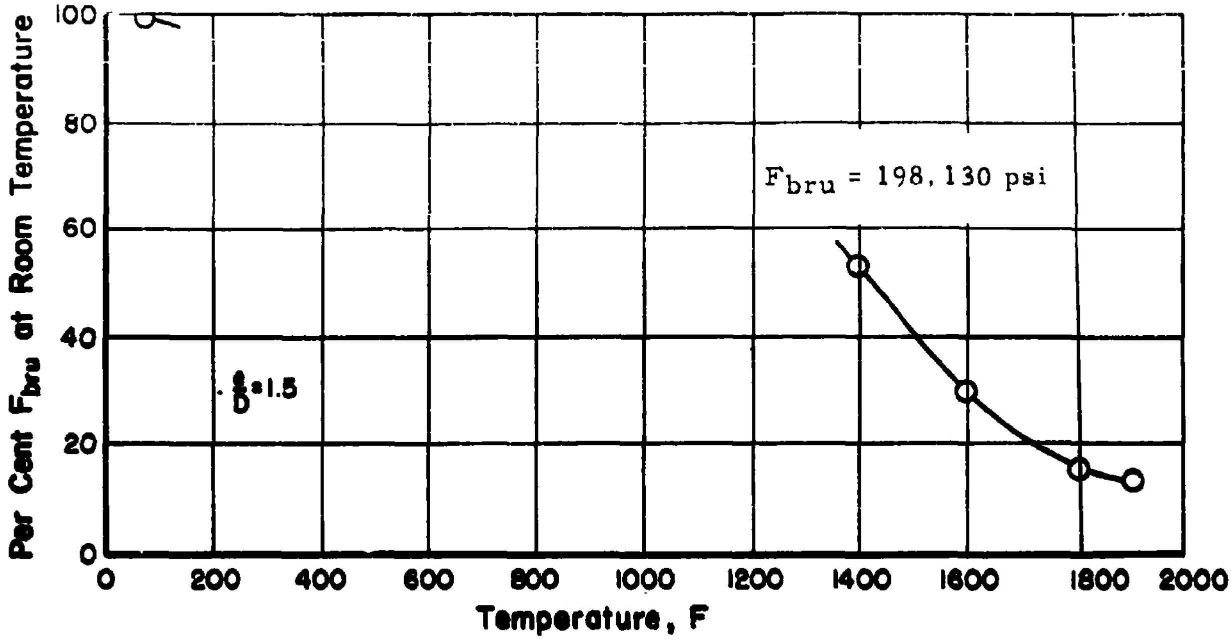


FIGURE 241. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 10 HOURS

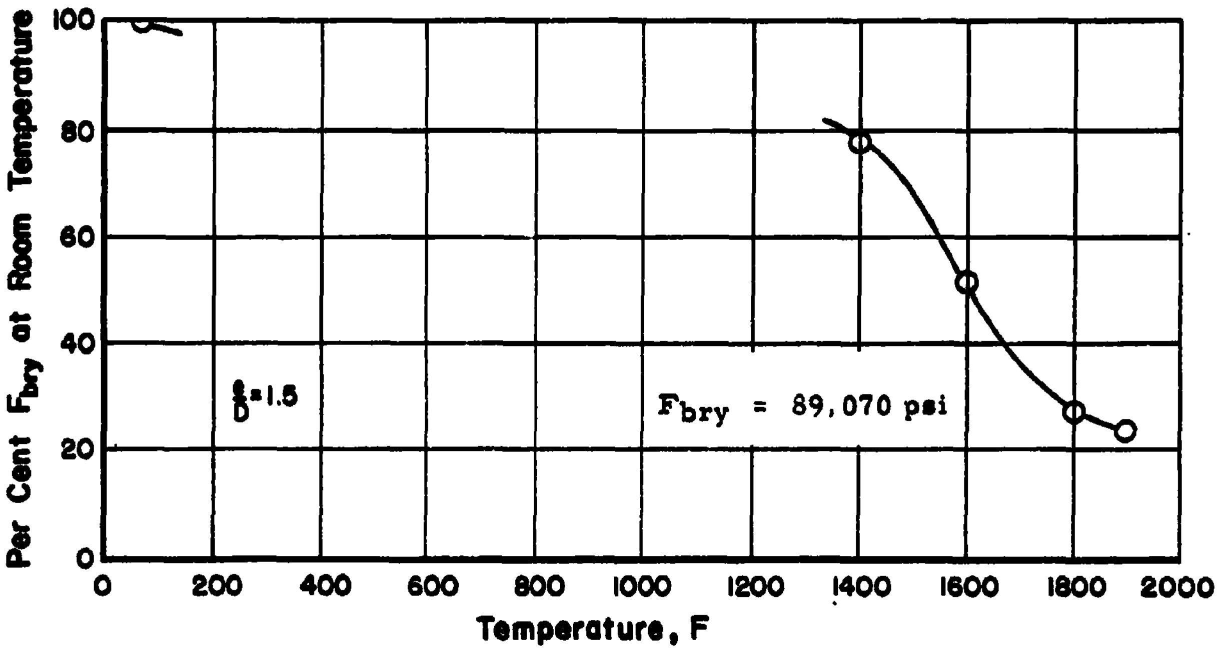


FIGURE 242. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 10 HOURS

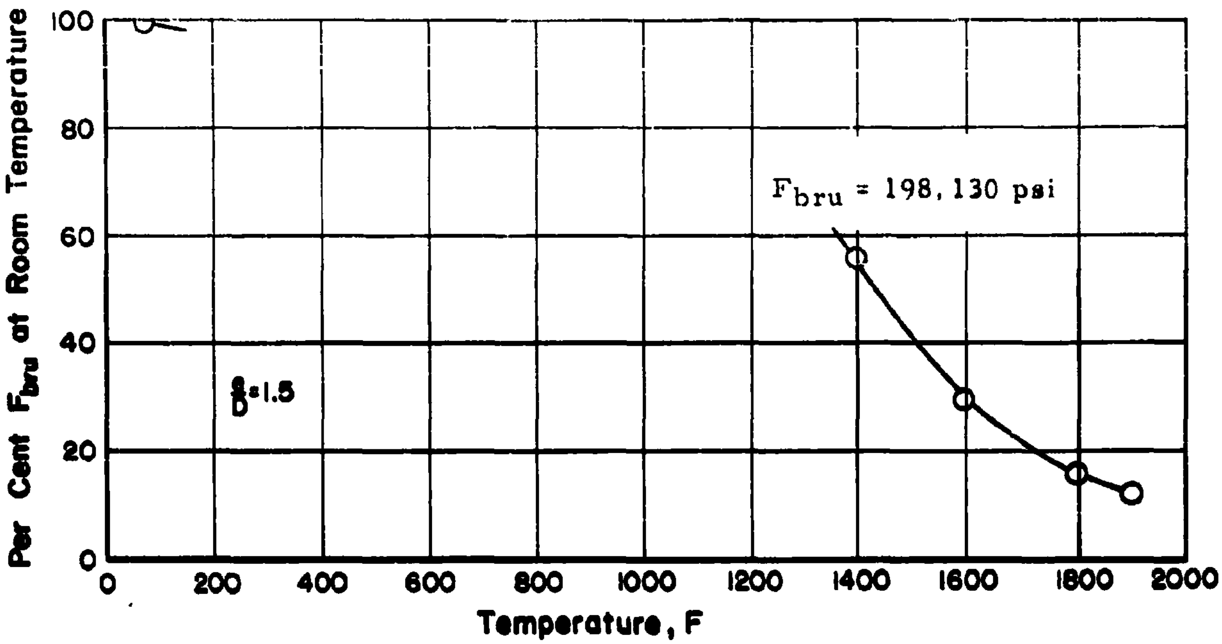


FIGURE 243. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 100 HOURS

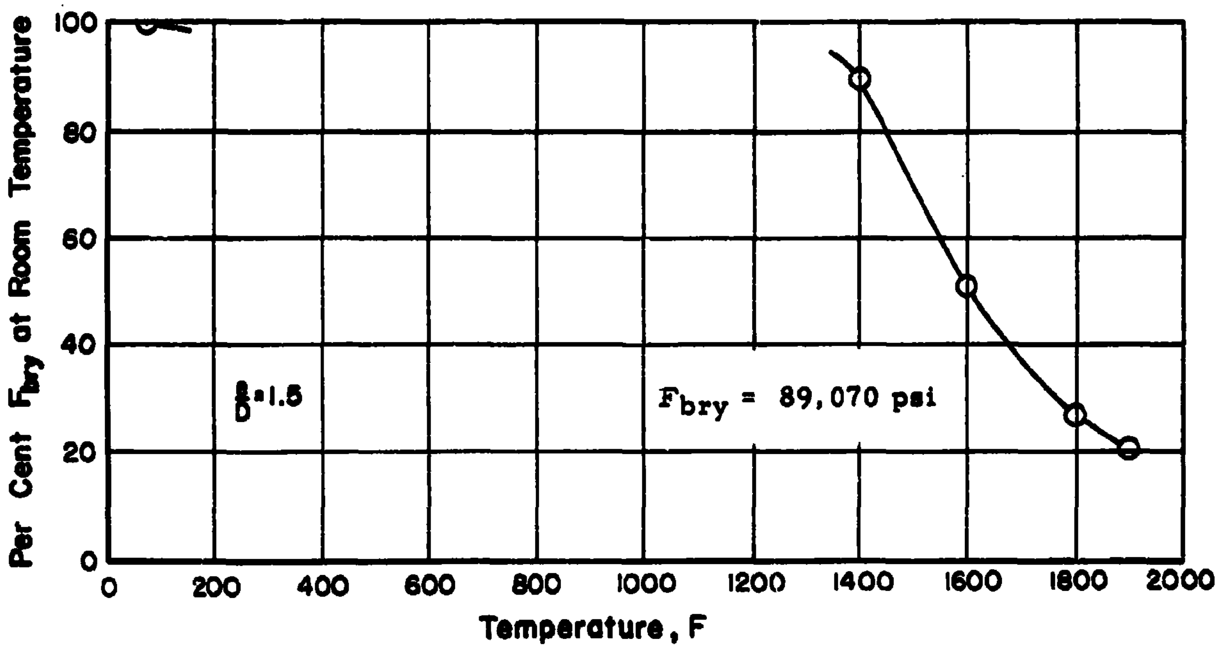


FIGURE 244. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 100 HOURS

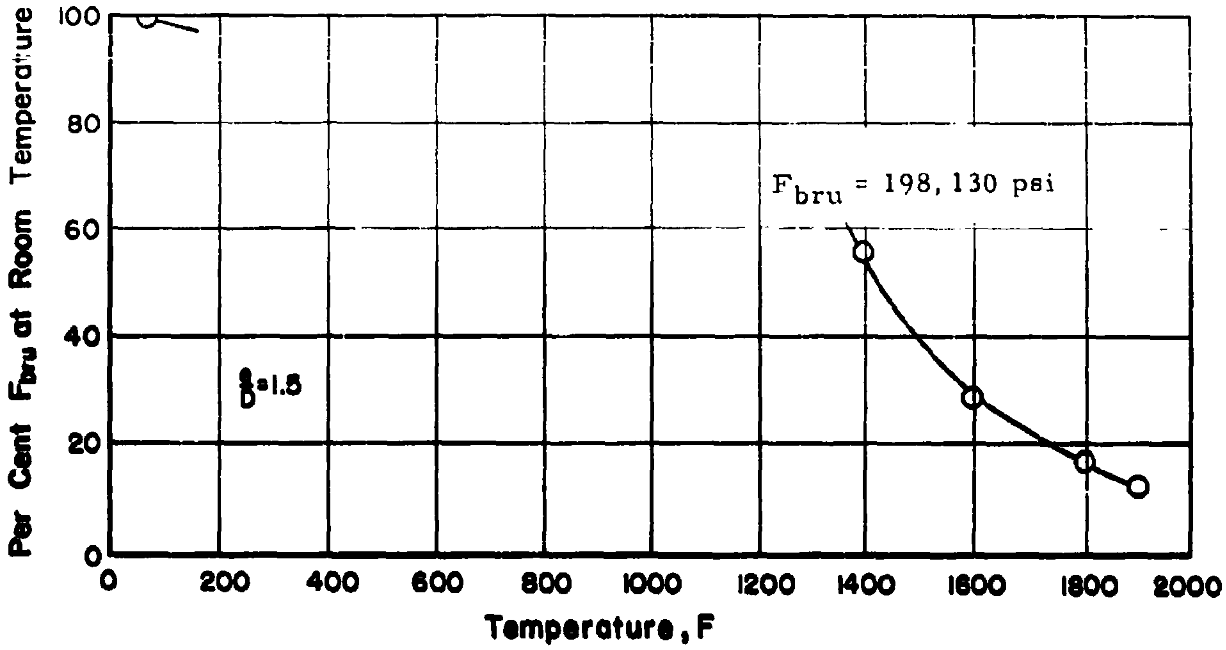


FIGURE 245. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 1000 HOURS

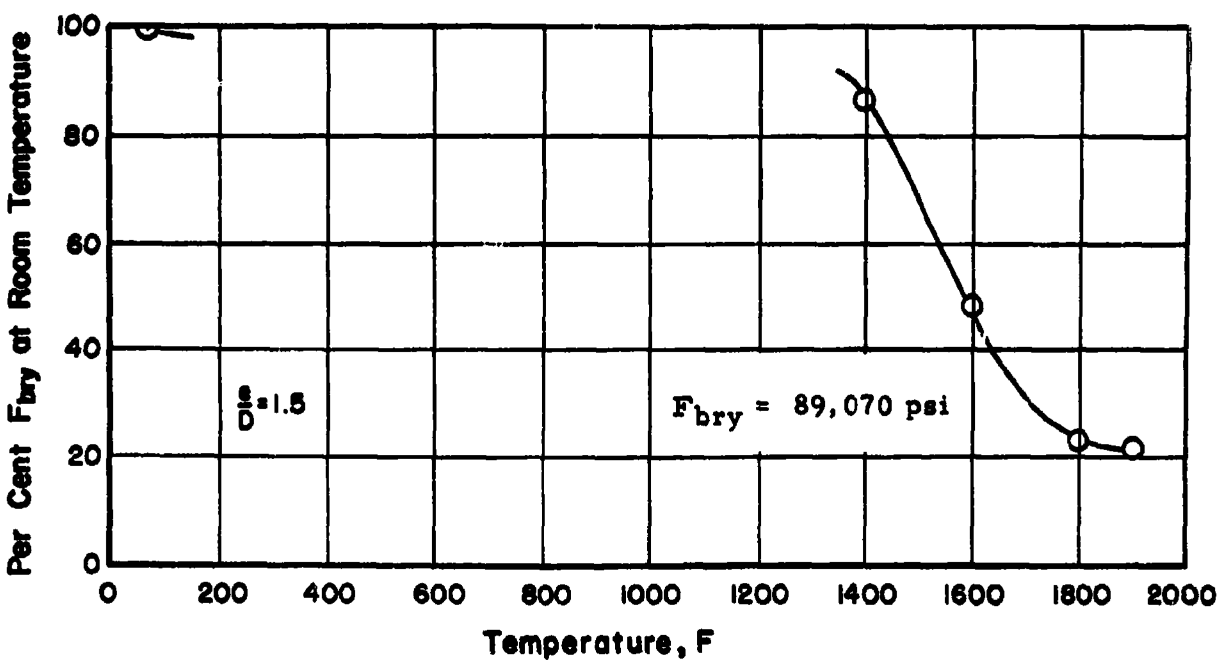


FIGURE 246. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 1000 HOURS

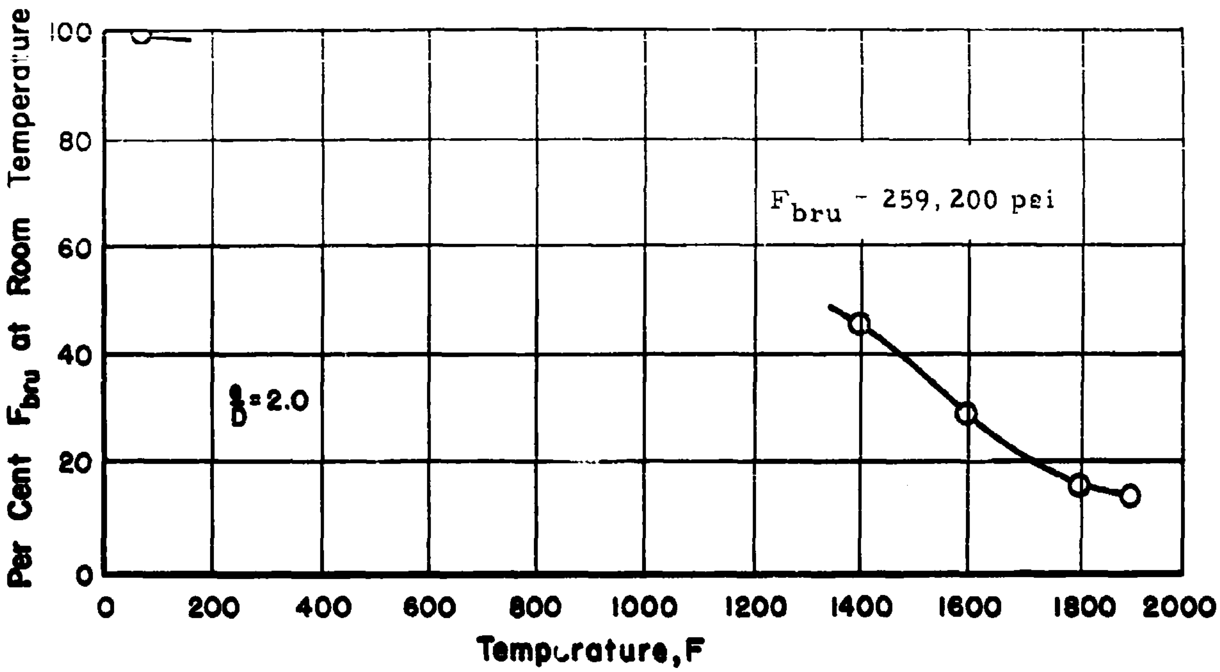


FIGURE 247. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 0.5 HOURS

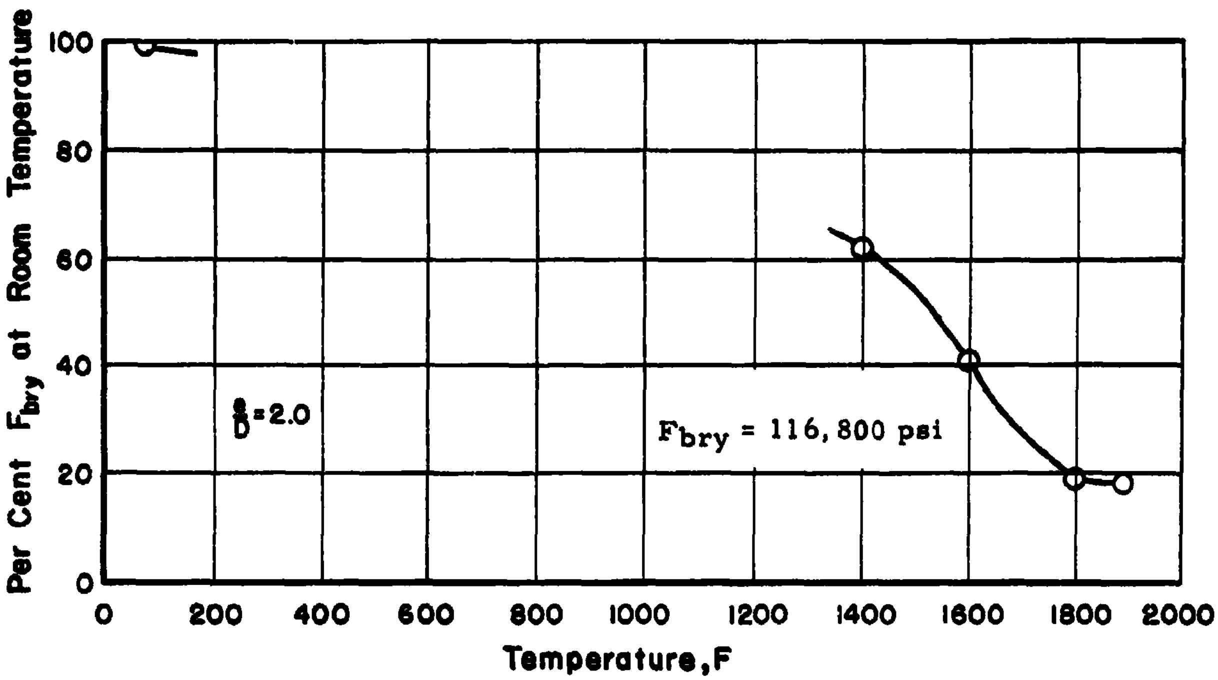


FIGURE 248. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 0.5 HOURS

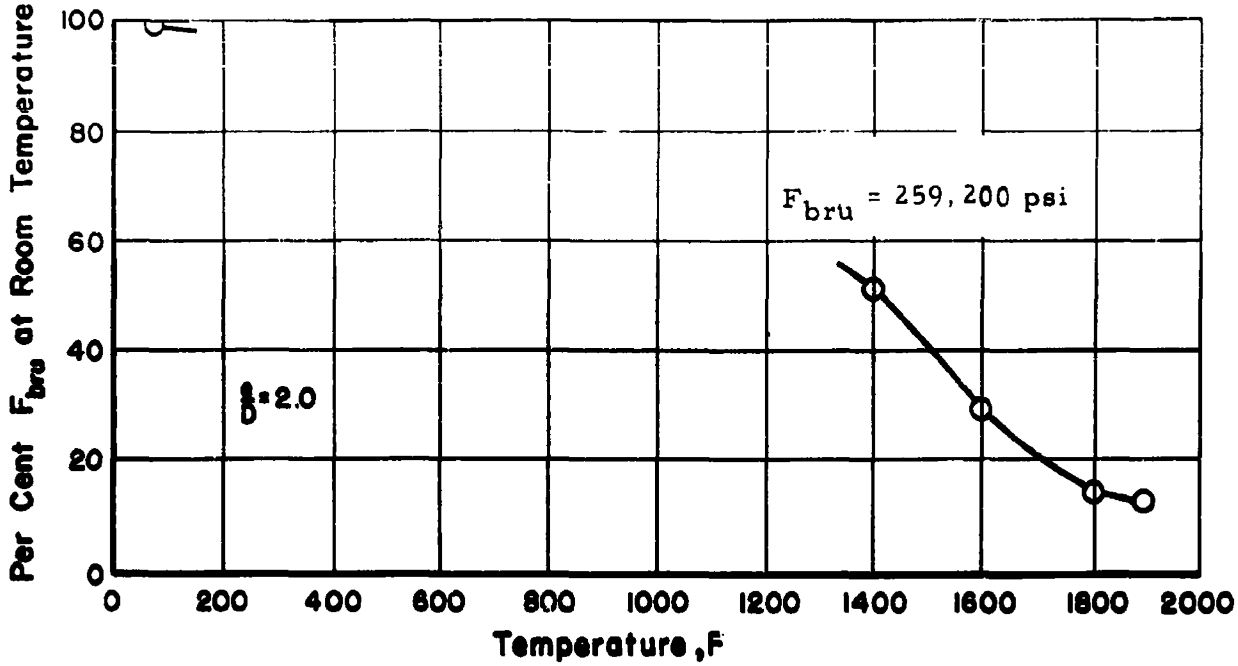


FIGURE 249. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 10 HOURS

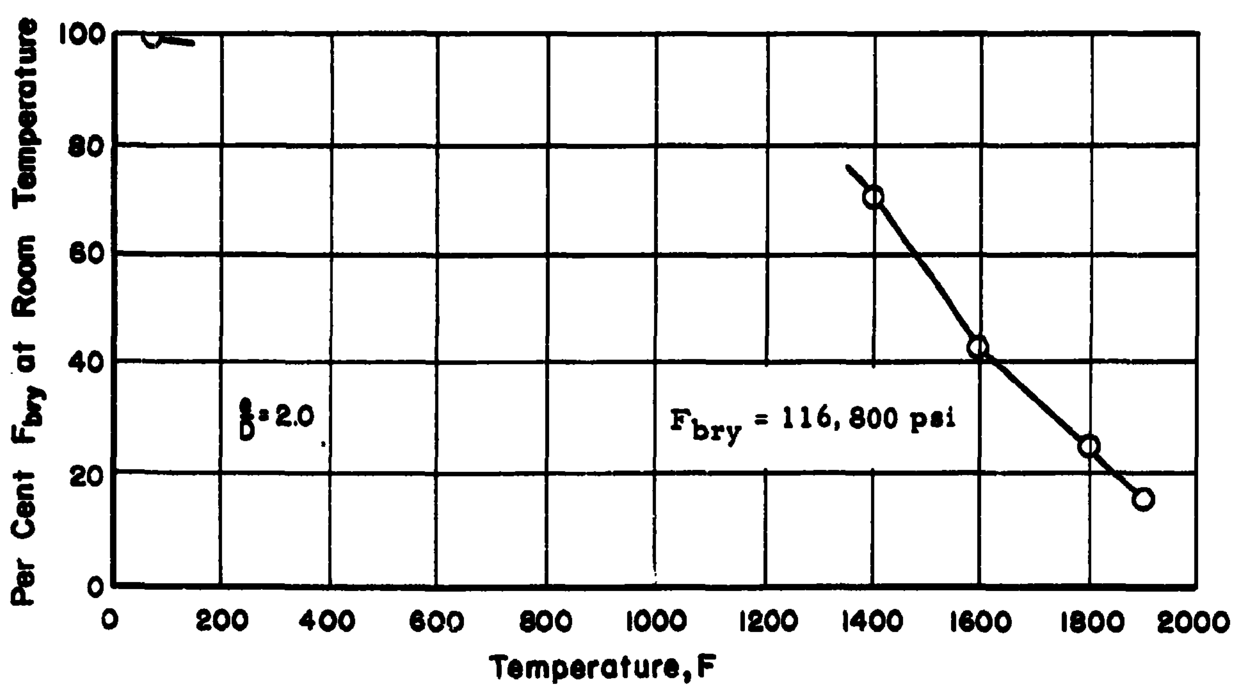


FIGURE 250. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 10 HOURS

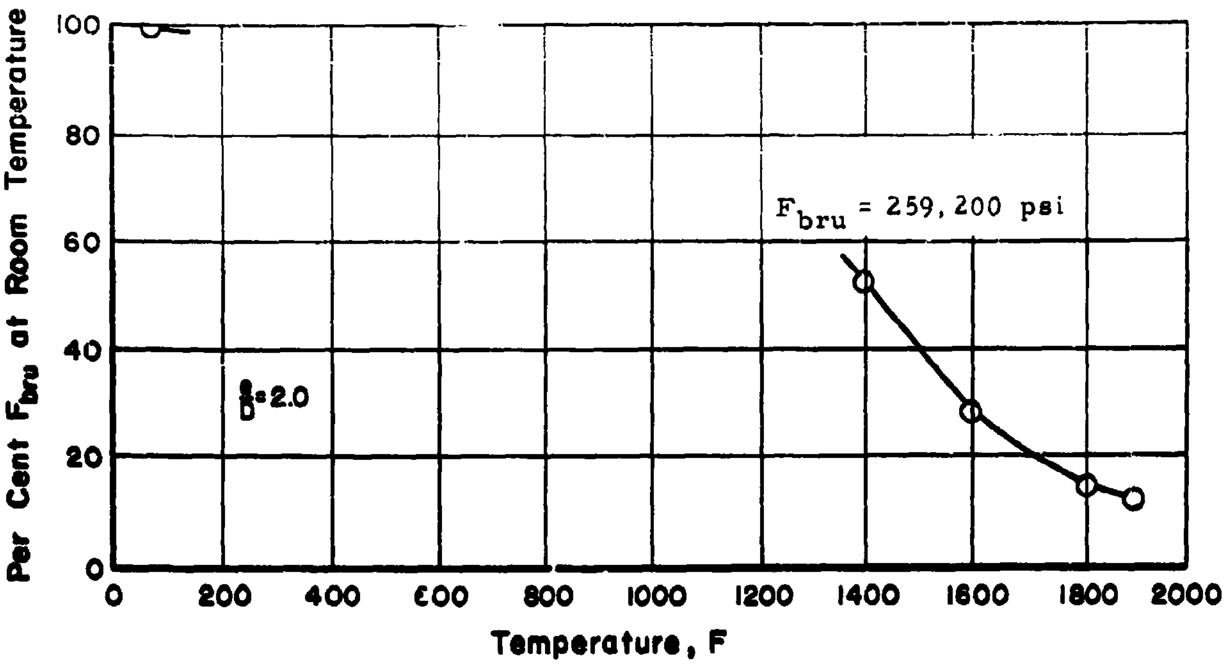


FIGURE 251. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 100 HOURS

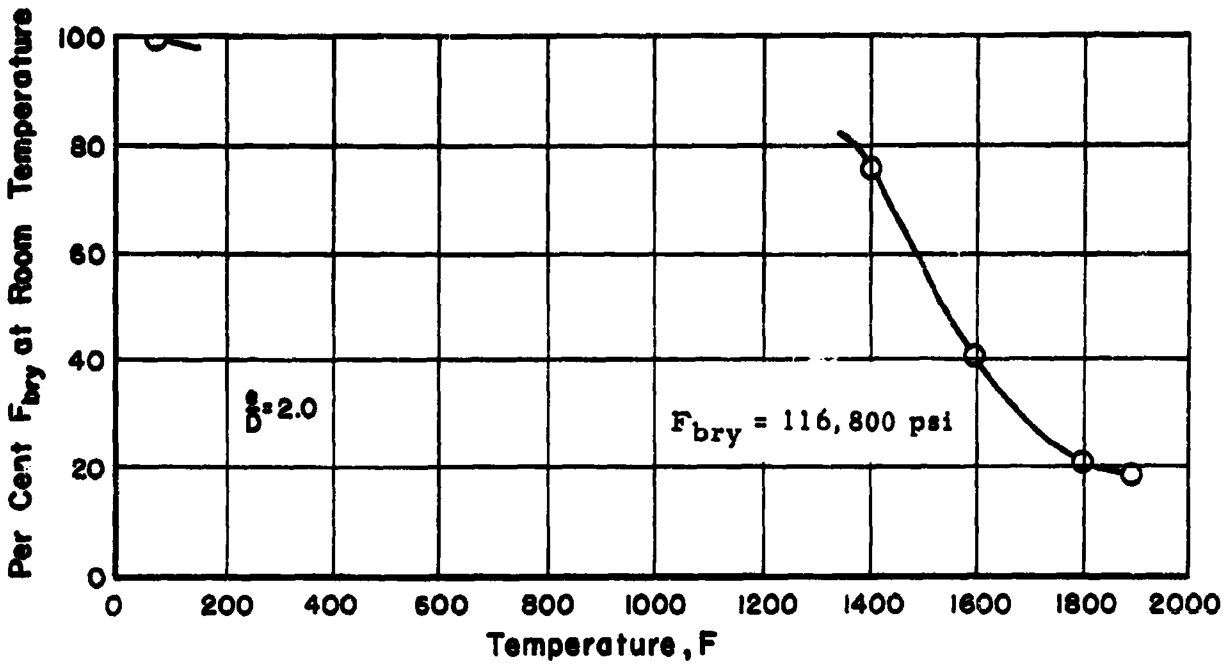


FIGURE 252. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 100 HOURS

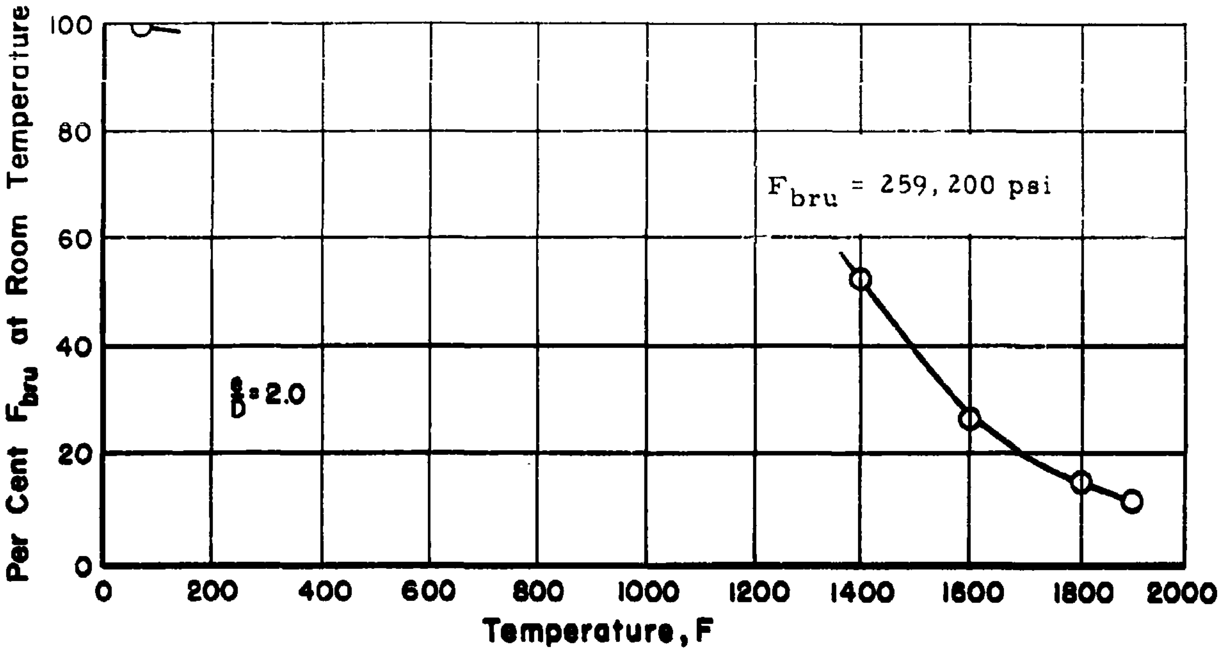


FIGURE 253. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 1000 HOURS

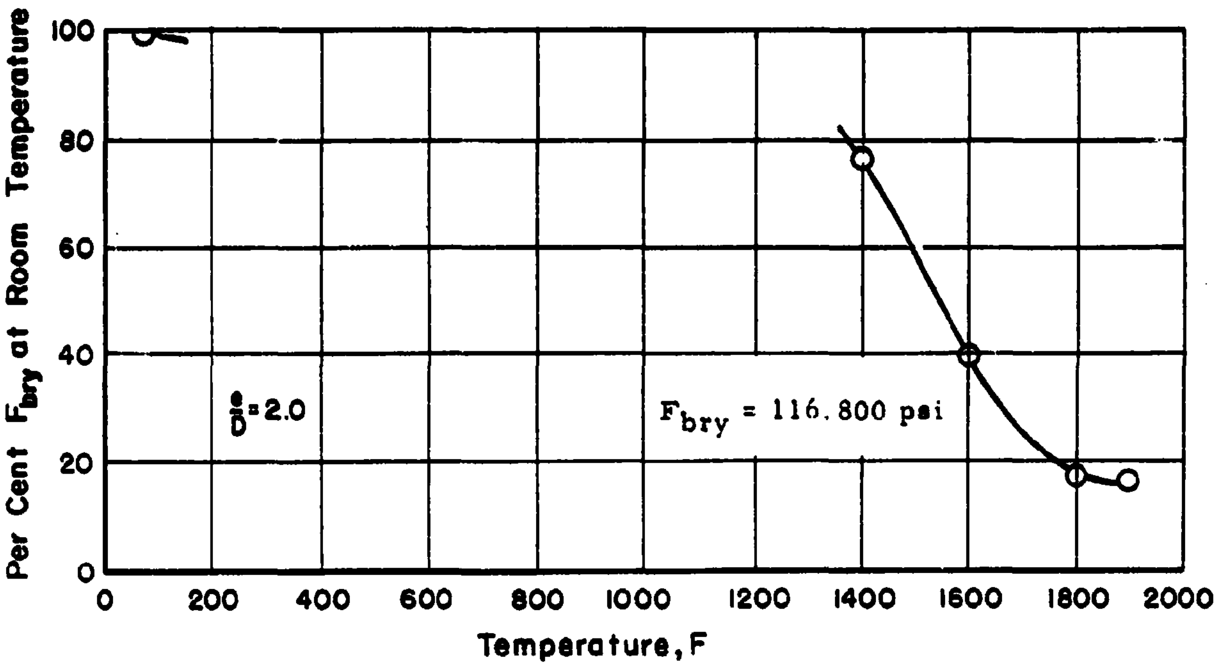


FIGURE 254. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 1000 HOURS

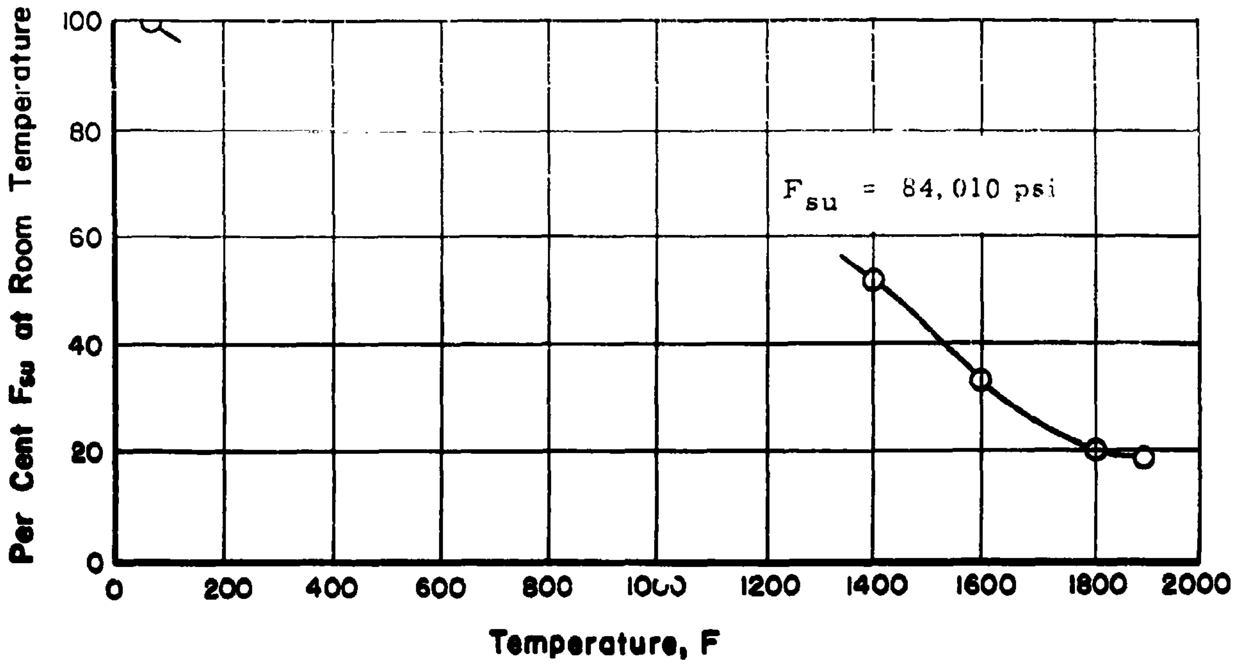


FIGURE 255. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF N-155 EXPOSED 0.5 HOURS

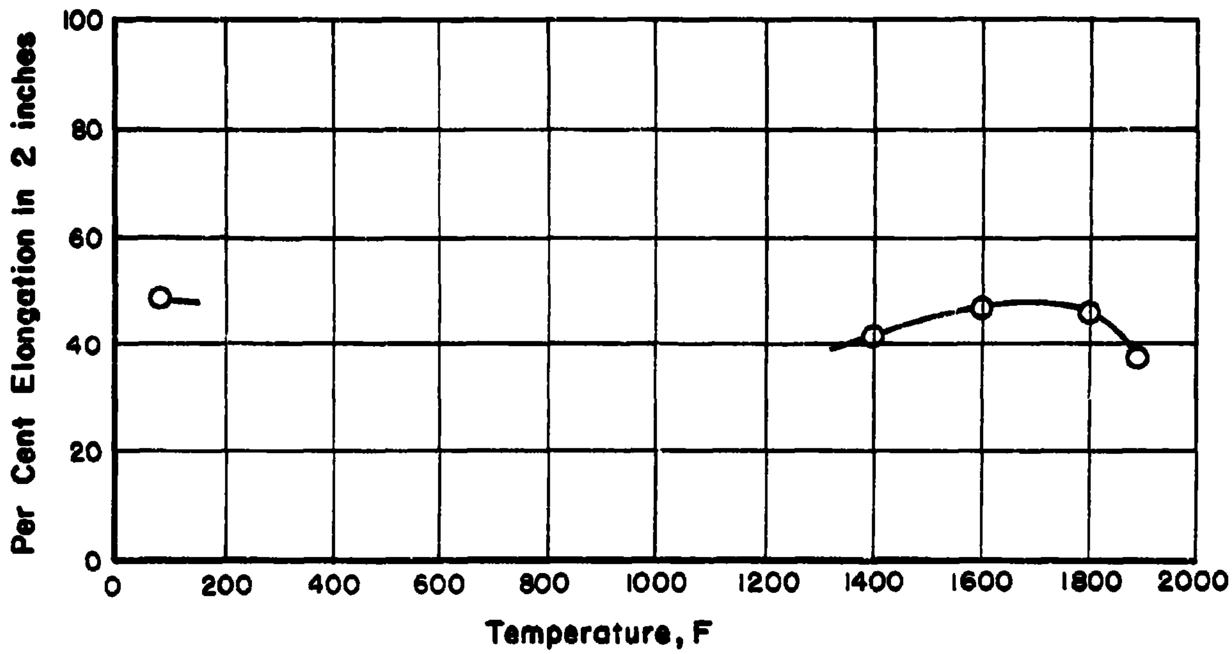


FIGURE 256. EFFECT OF TEMPERATURE ON ELONGATION OF N-155 EXPOSED 0.5 HOURS

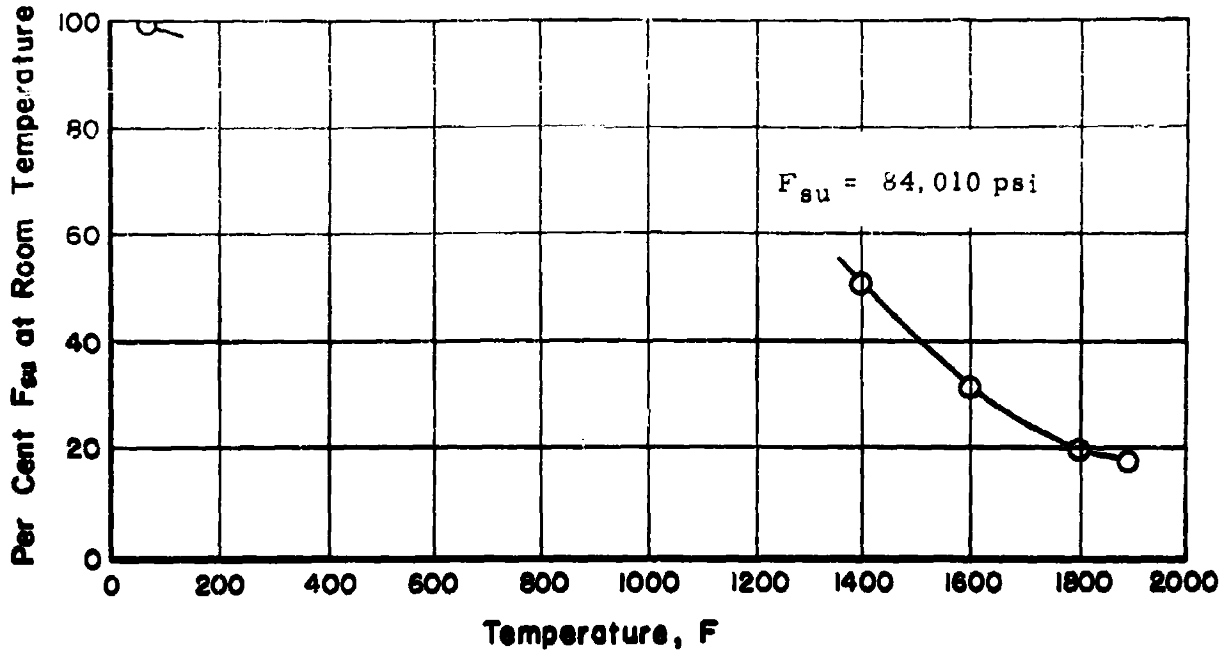


FIGURE 257. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF N-155 EXPOSED 10 HOURS

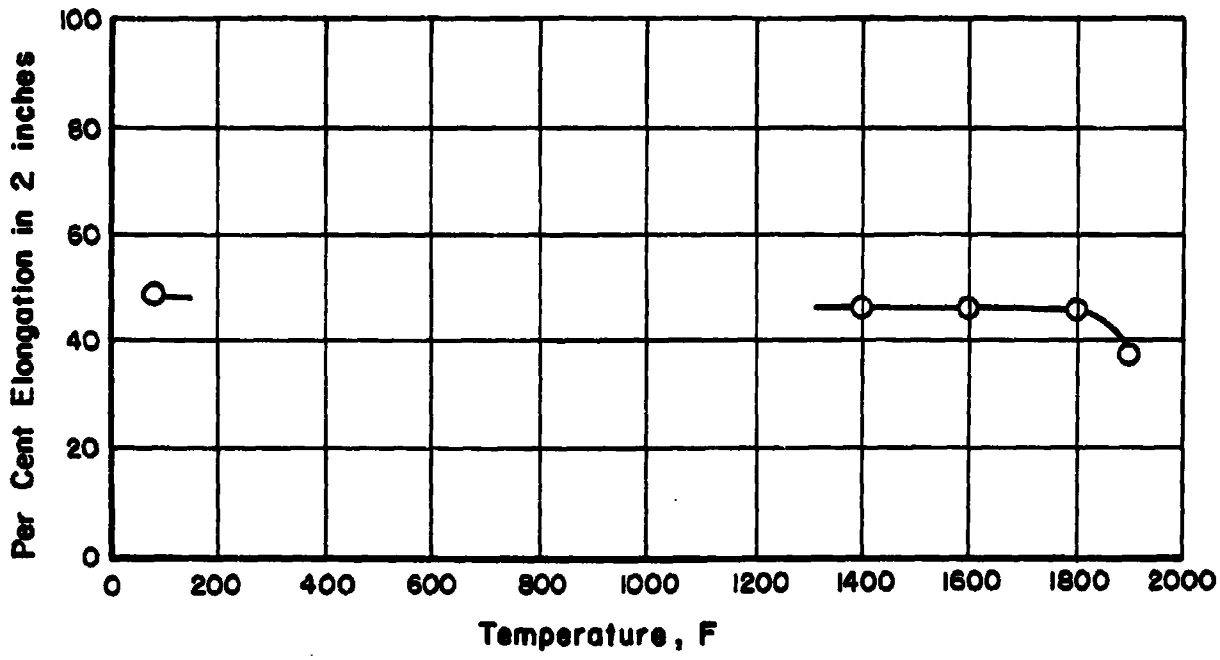


FIGURE 258. EFFECT OF TEMPERATURE ON ELONGATION OF N-155 EXPOSED 10 HOURS

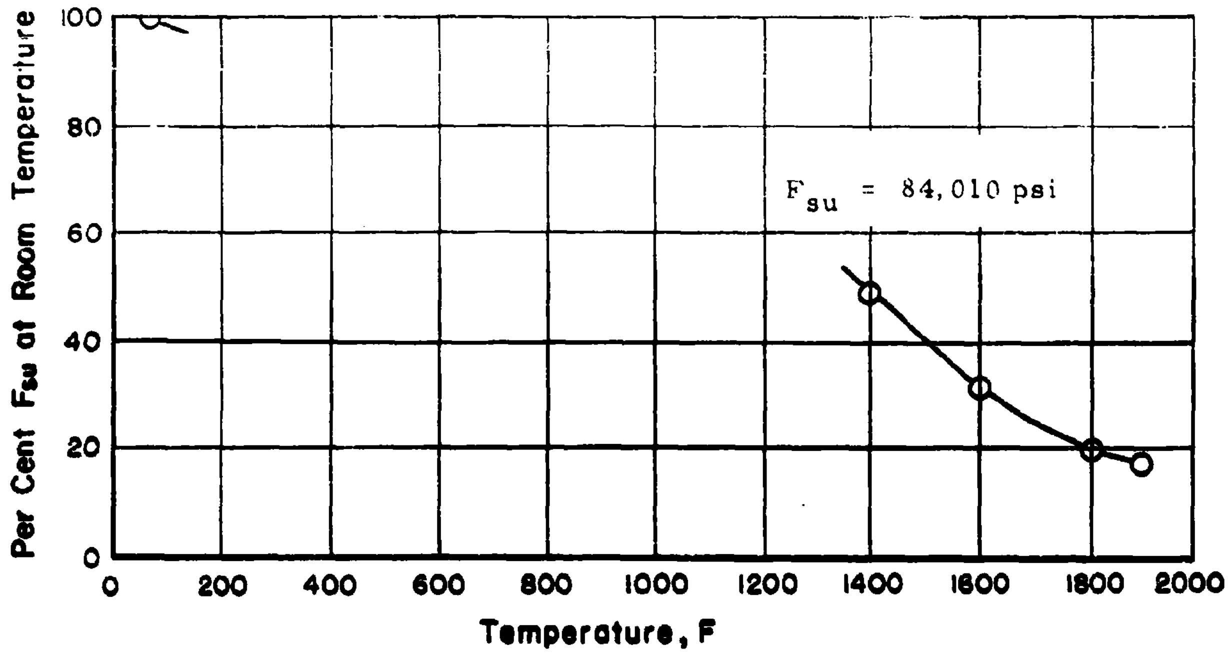


FIGURE 259. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF N-155 EXPOSED 100 HOURS

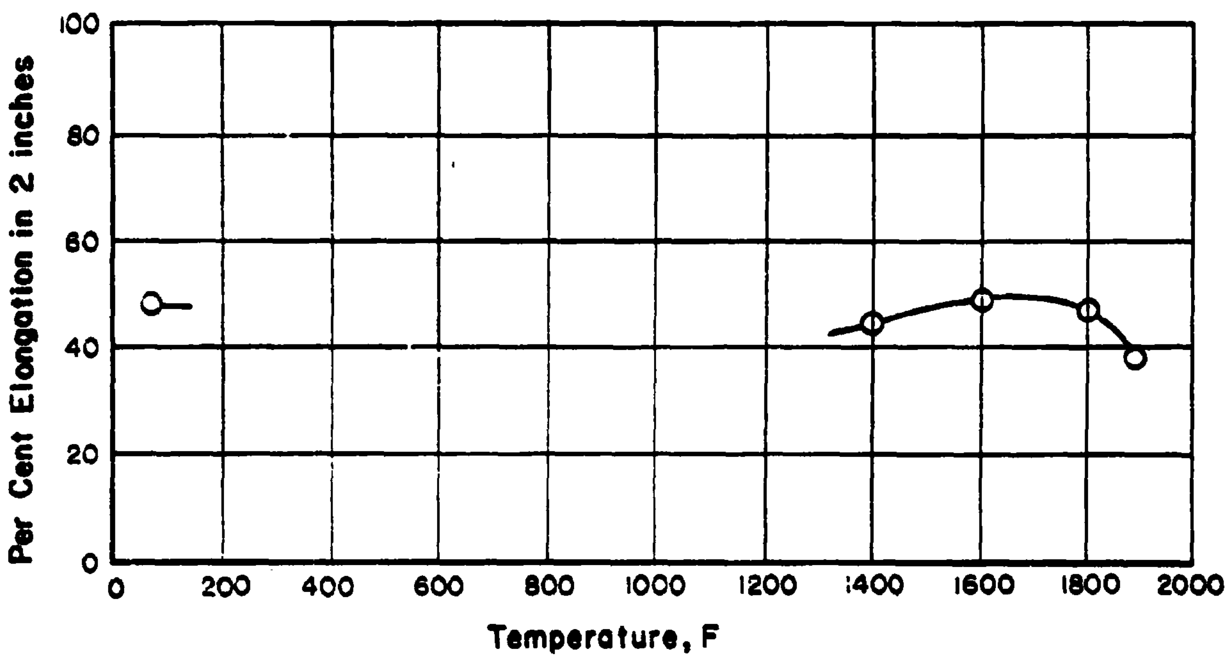


FIGURE 260. EFFECT OF TEMPERATURE ON ELONGATION OF N-155 EXPOSED 100 HOURS

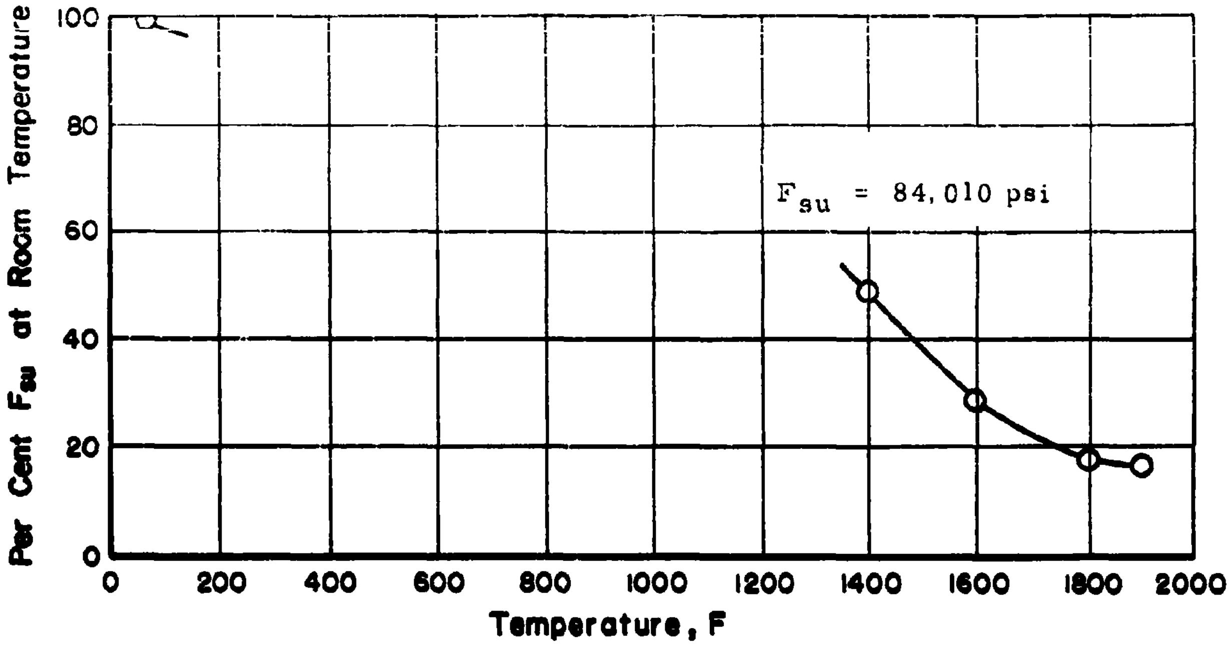


FIGURE 261. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF N-155 EXPOSED 1000 HOURS

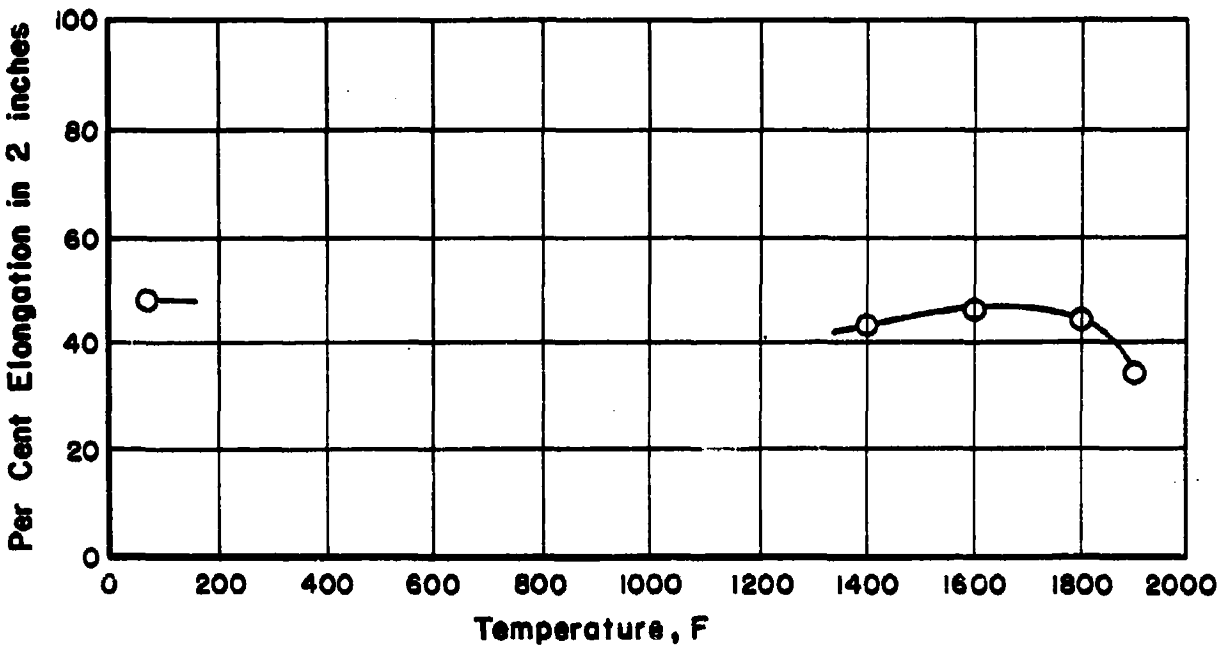


FIGURE 262. EFFECT OF TEMPERATURE ON ELONGATION OF N-155 EXPOSED 1000 HOURS

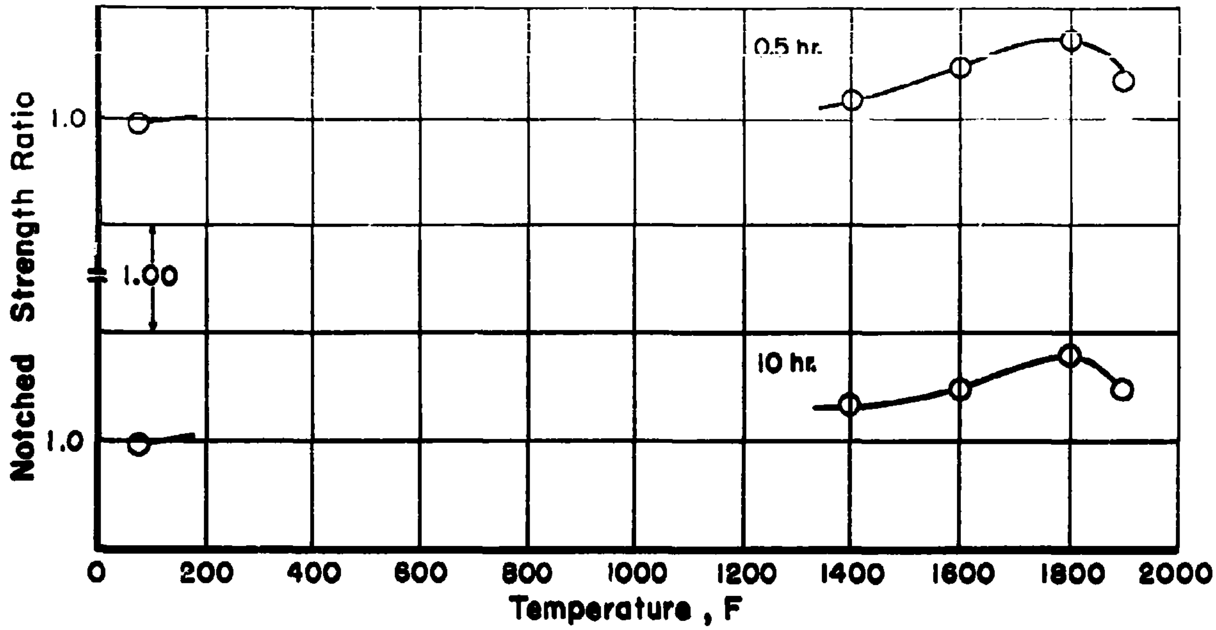


FIGURE 263. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF N-155 EXPOSED 0.5 AND 10 HOURS

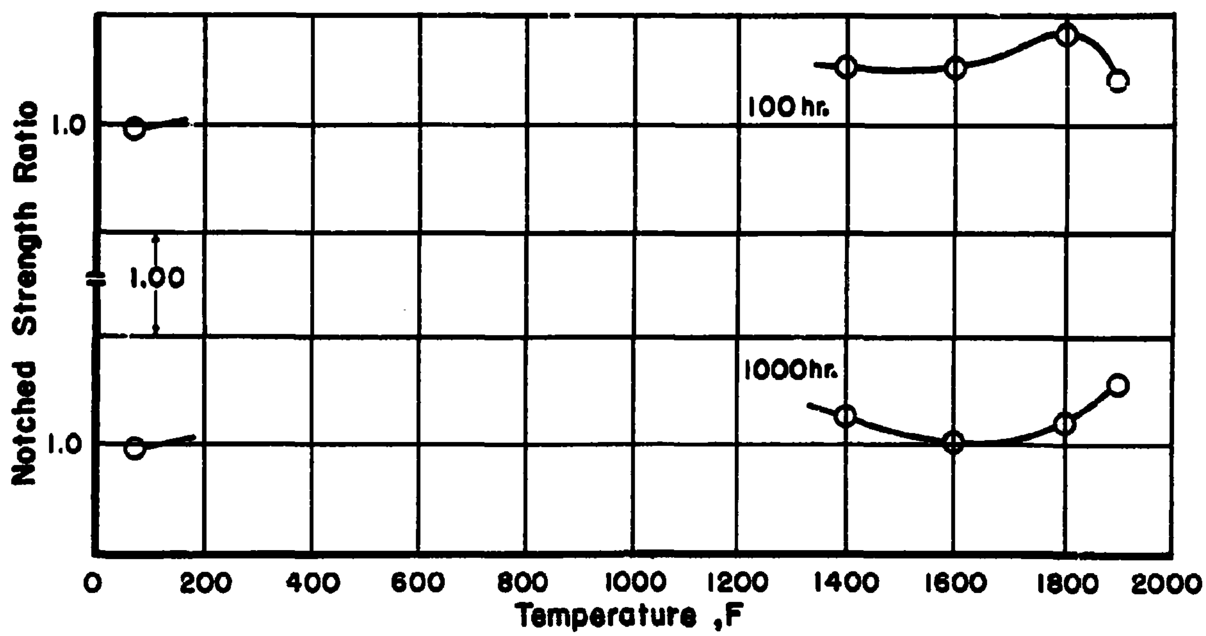


FIGURE 264. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF N-155 EXPOSED 100 AND 1000 HOURS

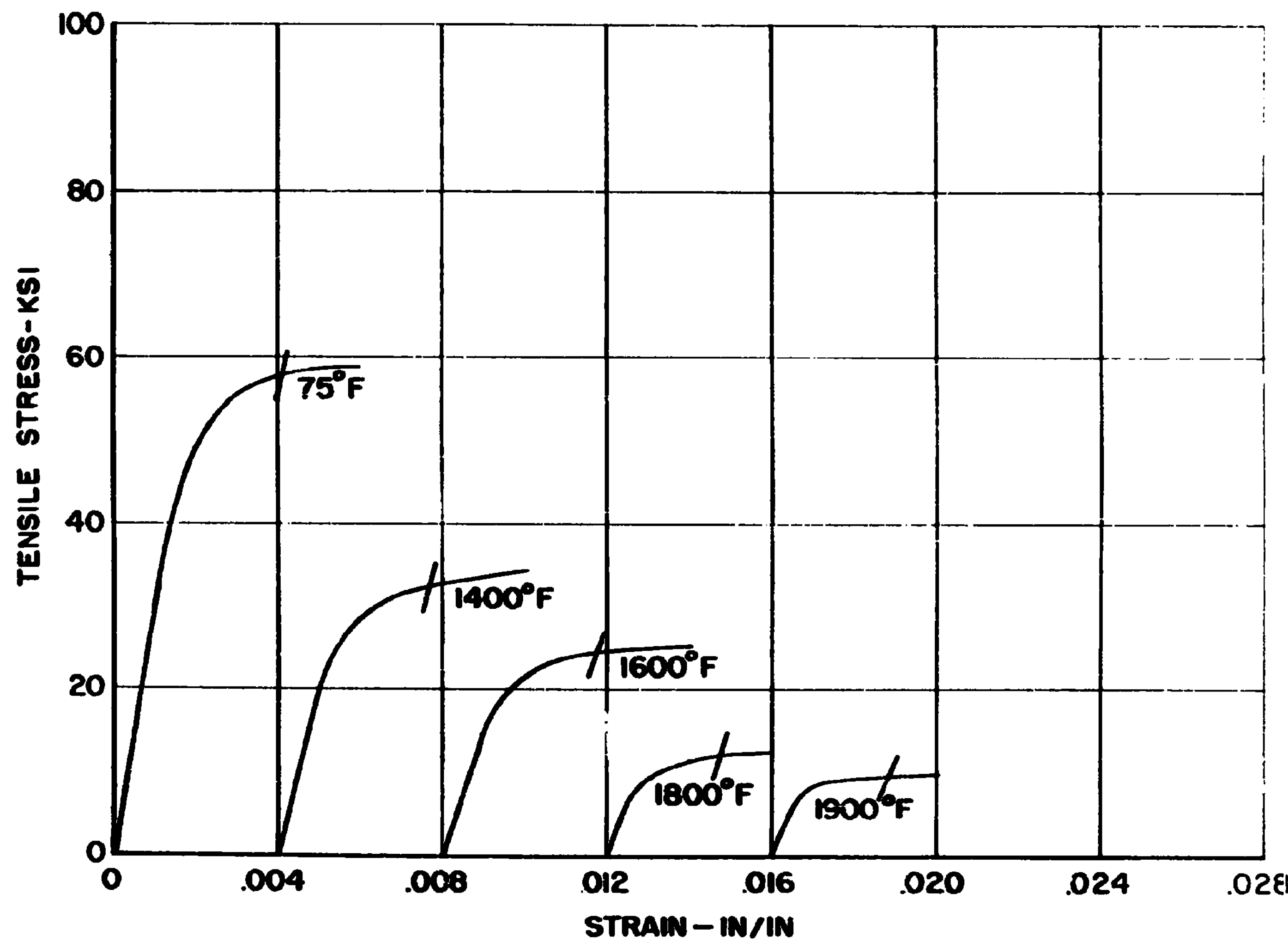


FIGURE 265. TENSILE STRESS-STRAIN CURVES OF N-155 EXPOSED 0.5 HOURS

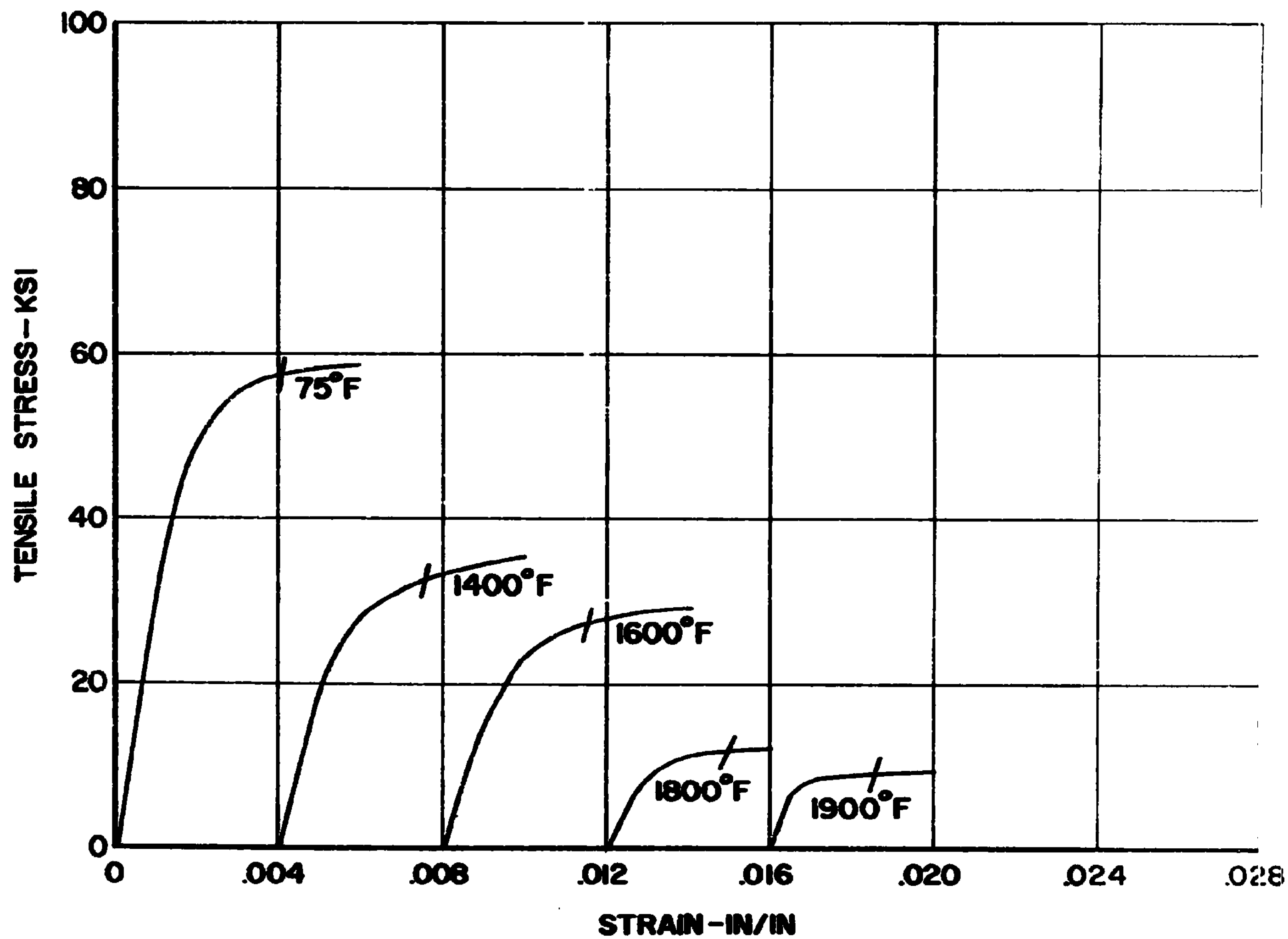


FIGURE 266. TENSILE STRESS-STRAIN CURVES OF N-155 EXPOSED 10 HOURS

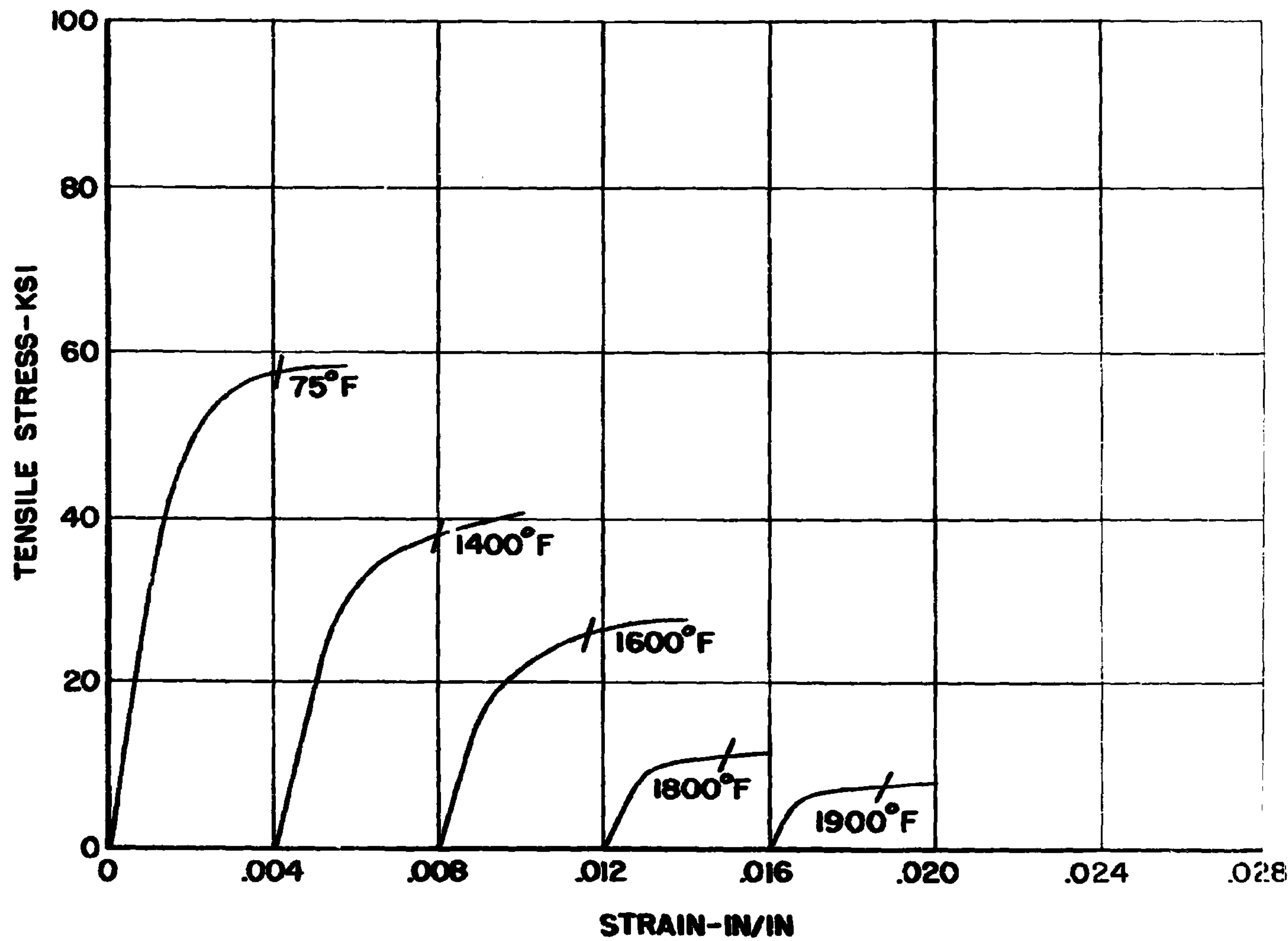


FIGURE 267. TENSILE STRESS-STRAIN CURVES OF N-155 EXPOSED 100 HOURS

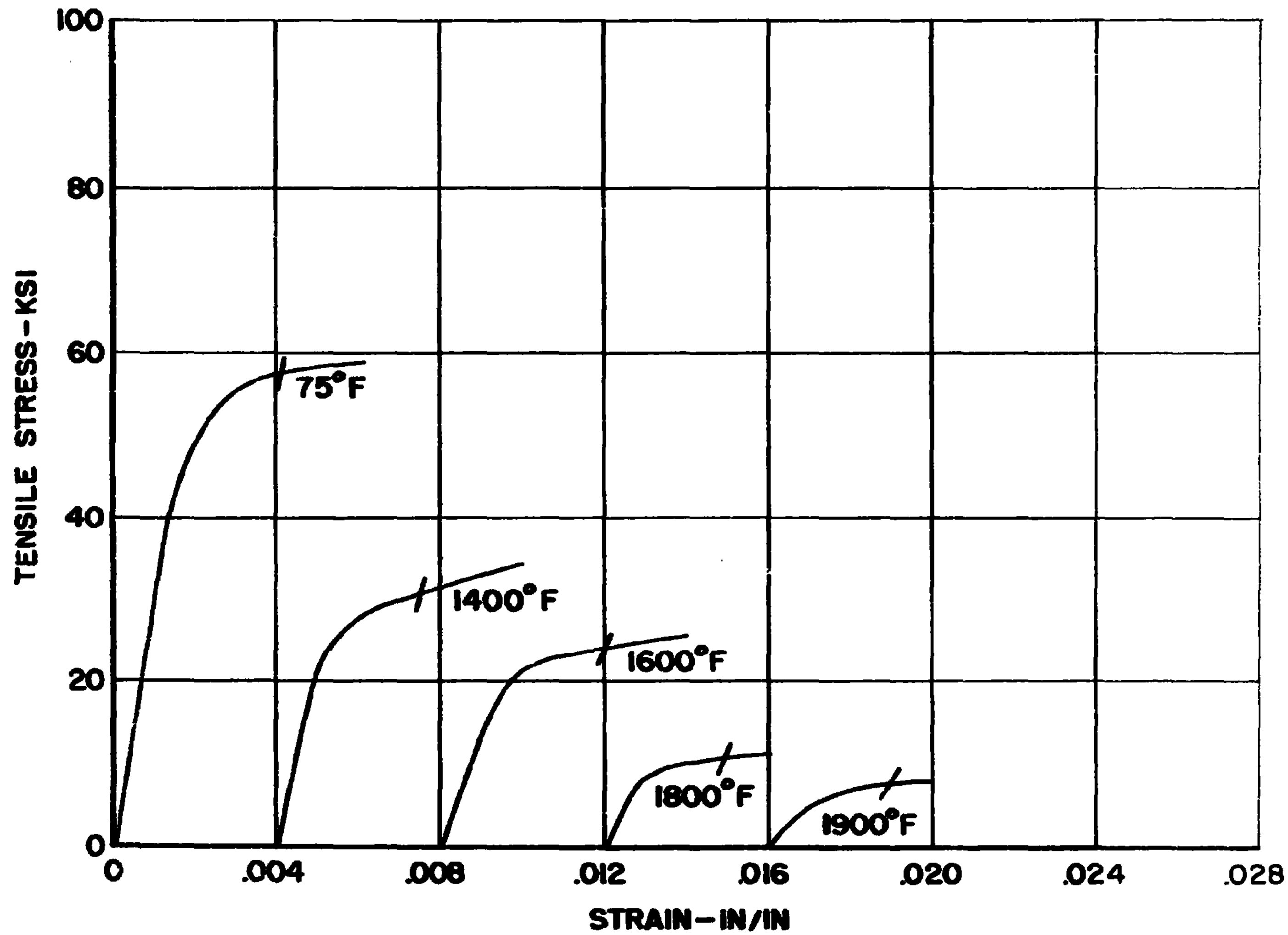


FIGURE 268. TENSILE STRESS-STRAIN CURVES OF N-155 EXPOSED 1000 HOURS

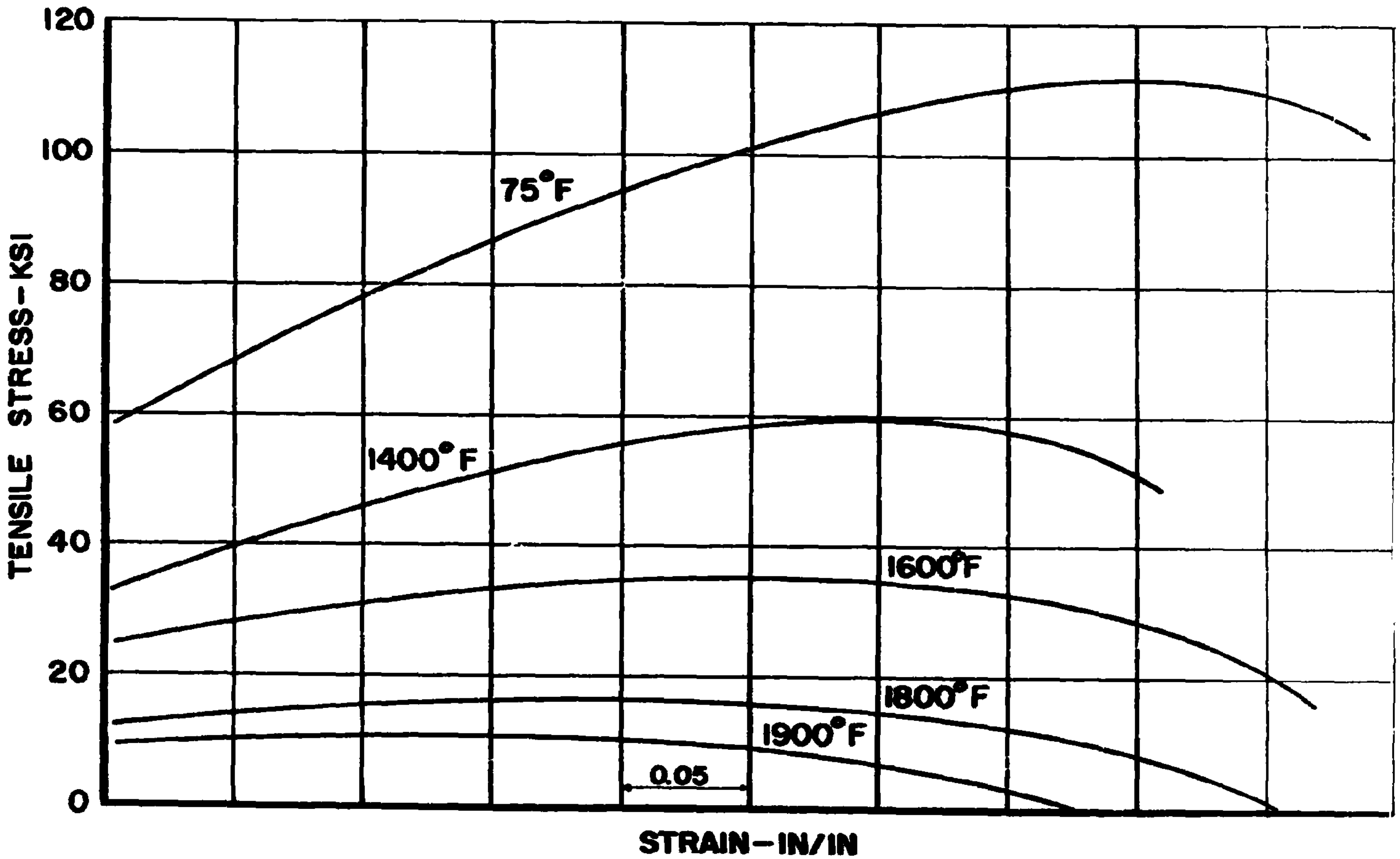


FIGURE 269. TENSILE POSTYIELD STRESS-STRAIN CURVES OF N-155 EXPOSED 0.5 HOURS

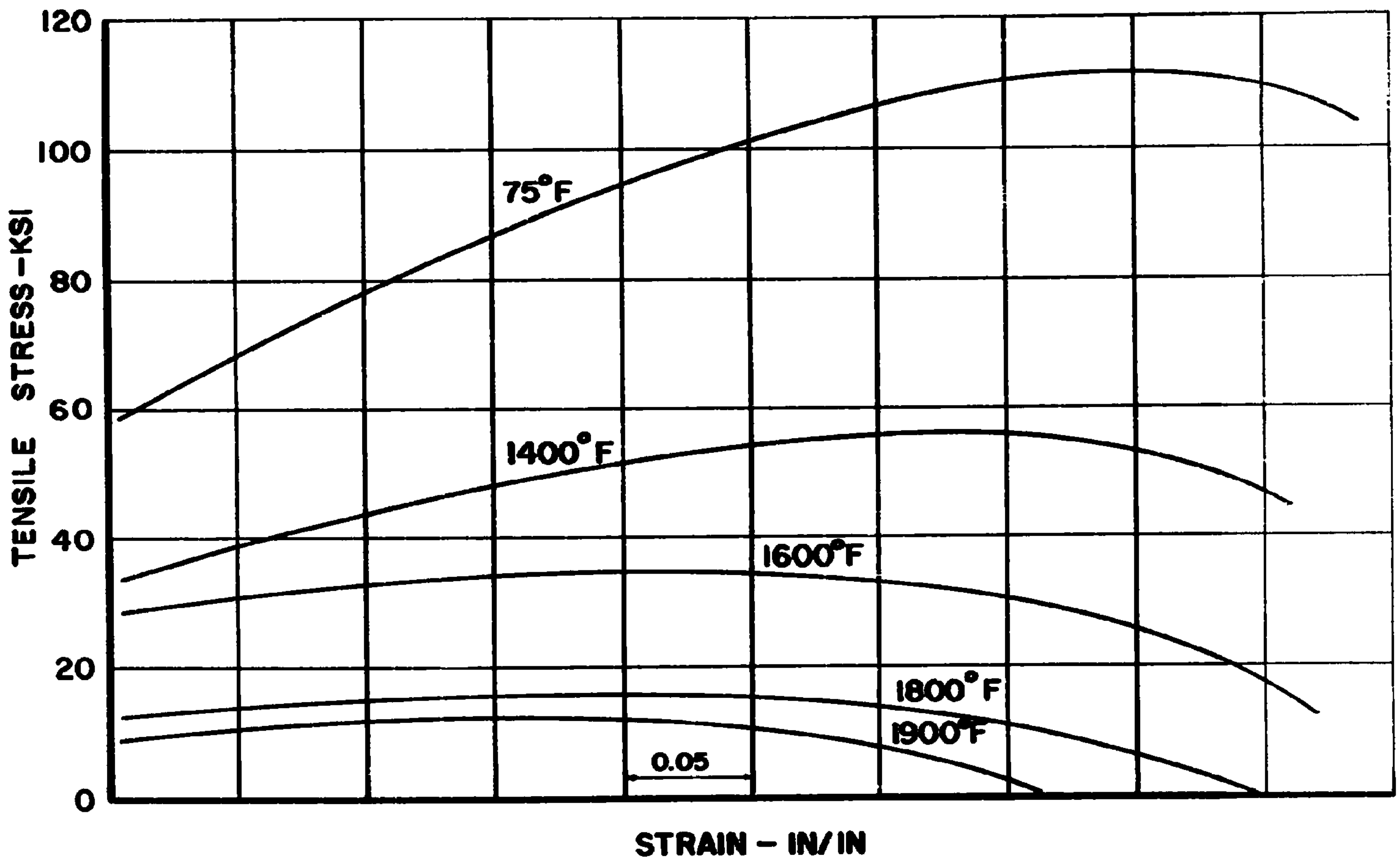


FIGURE 270. TENSILE POSTYIELD STRESS-STRAIN CURVES OF N-155 EXPOSED 10 HOURS

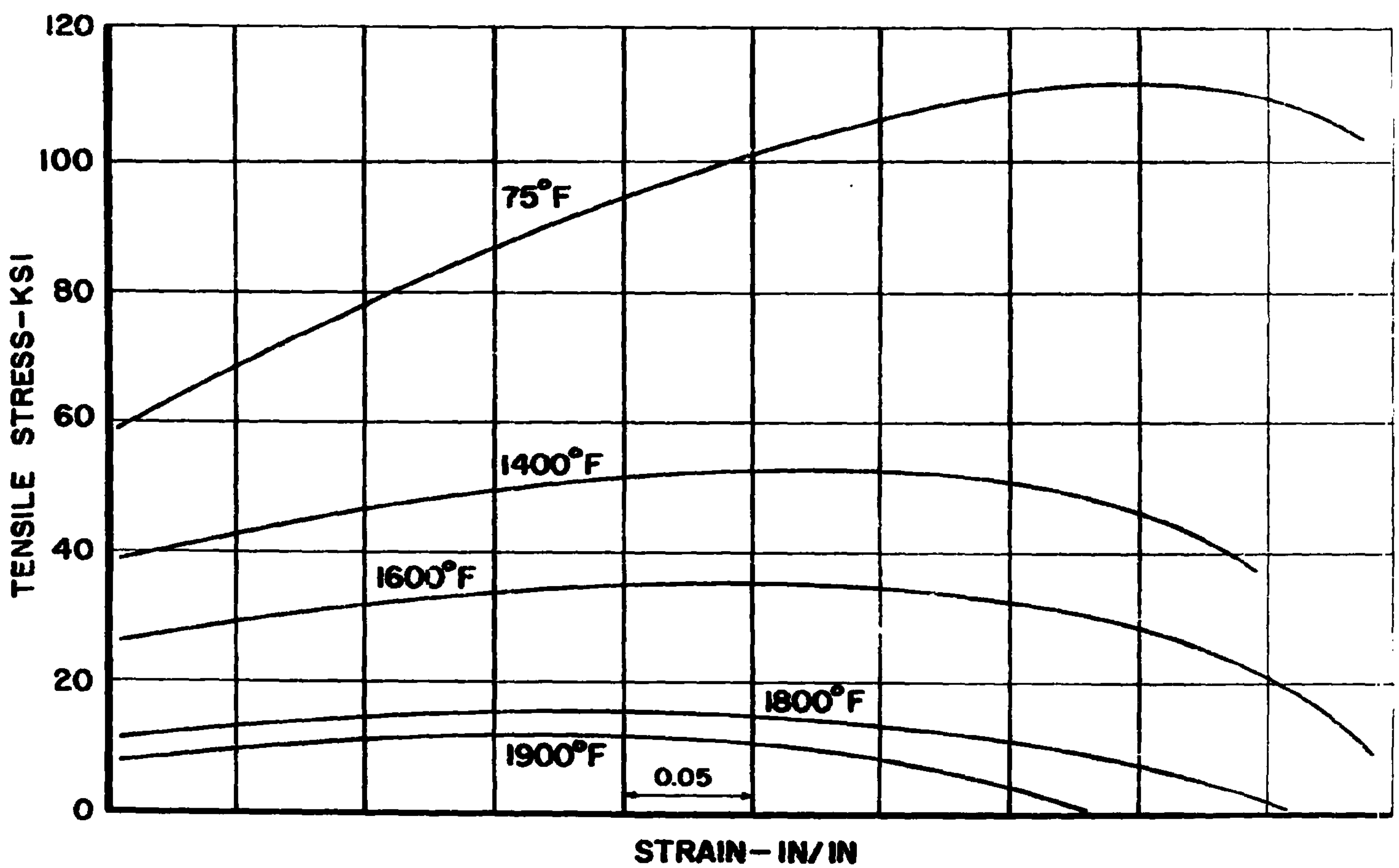


FIGURE 271. TENSILE POSTYIELD STRESS-STRAIN CURVES OF N-155 EXPOSED 100 HOURS

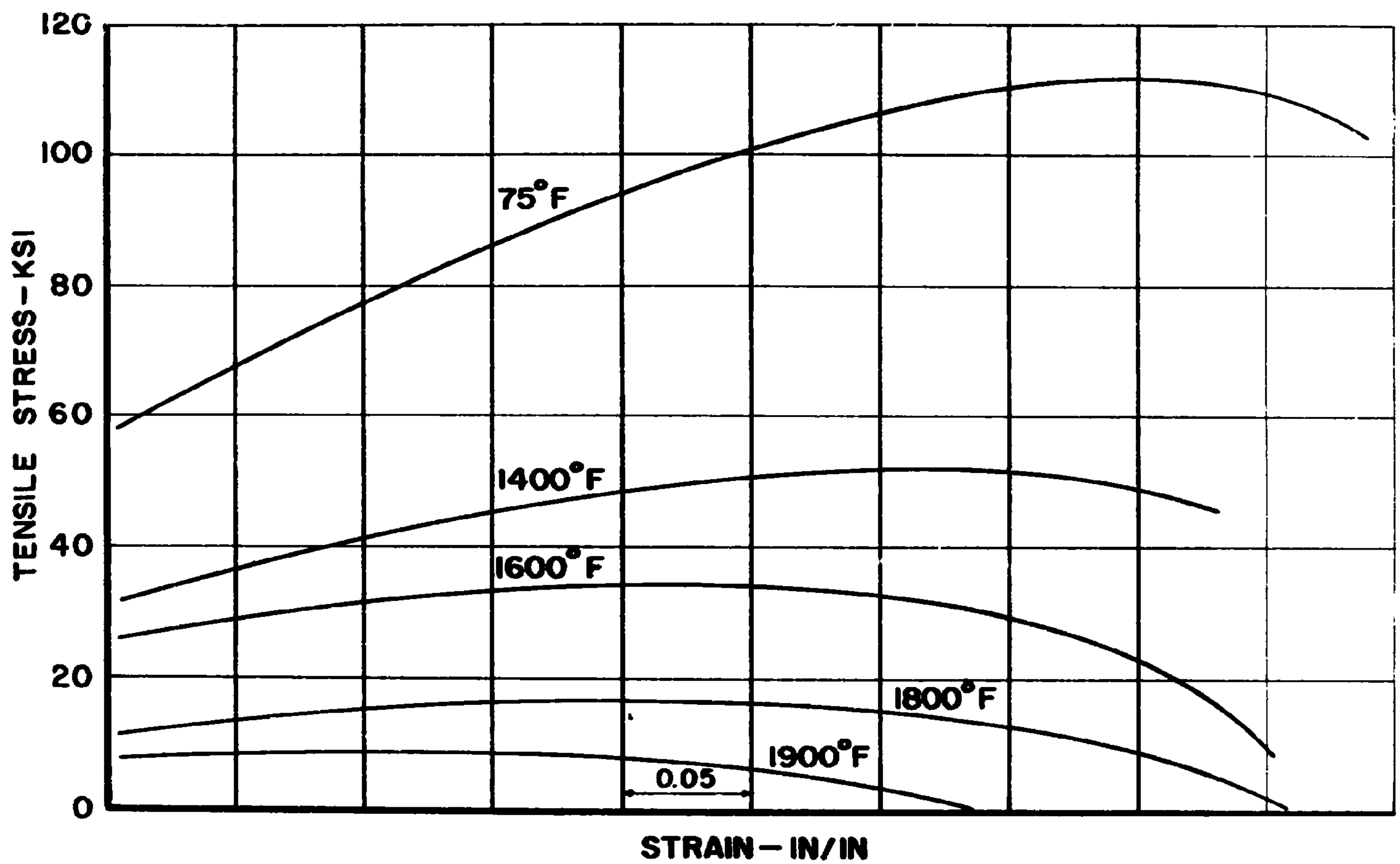


FIGURE 272. TENSILE POSTYIELD STRESS-STRAIN CURVES OF N-155 EXPOSED 1000 HOURS

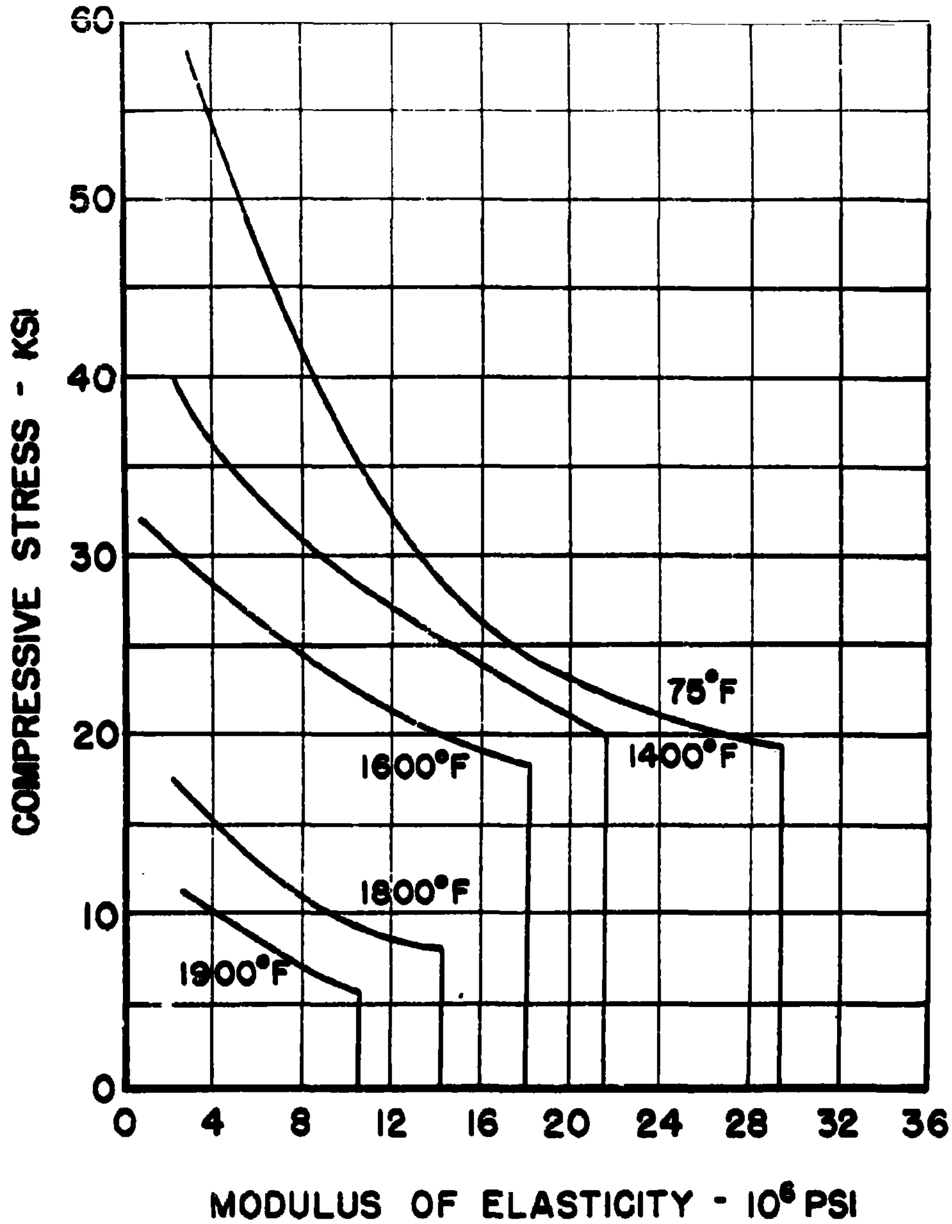


FIGURE 273. COMPRESSIVE TANGENT MODULUS CURVES OF N-155 EXPOSED 0.5 HOURS

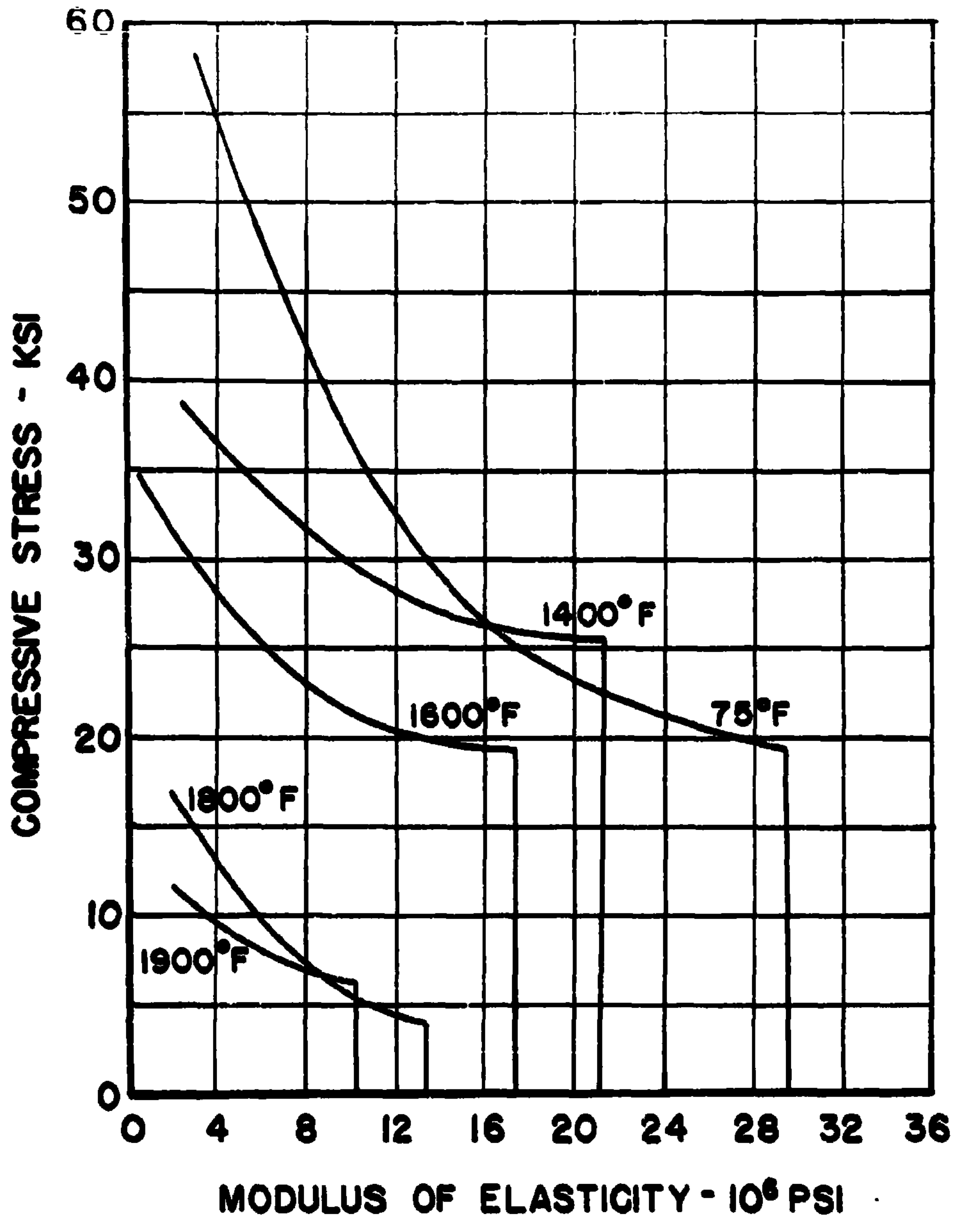


FIGURE 274. COMPRESSIVE TANGENT MODULUS CURVES OF N-155 EXPOSED 10 HOURS

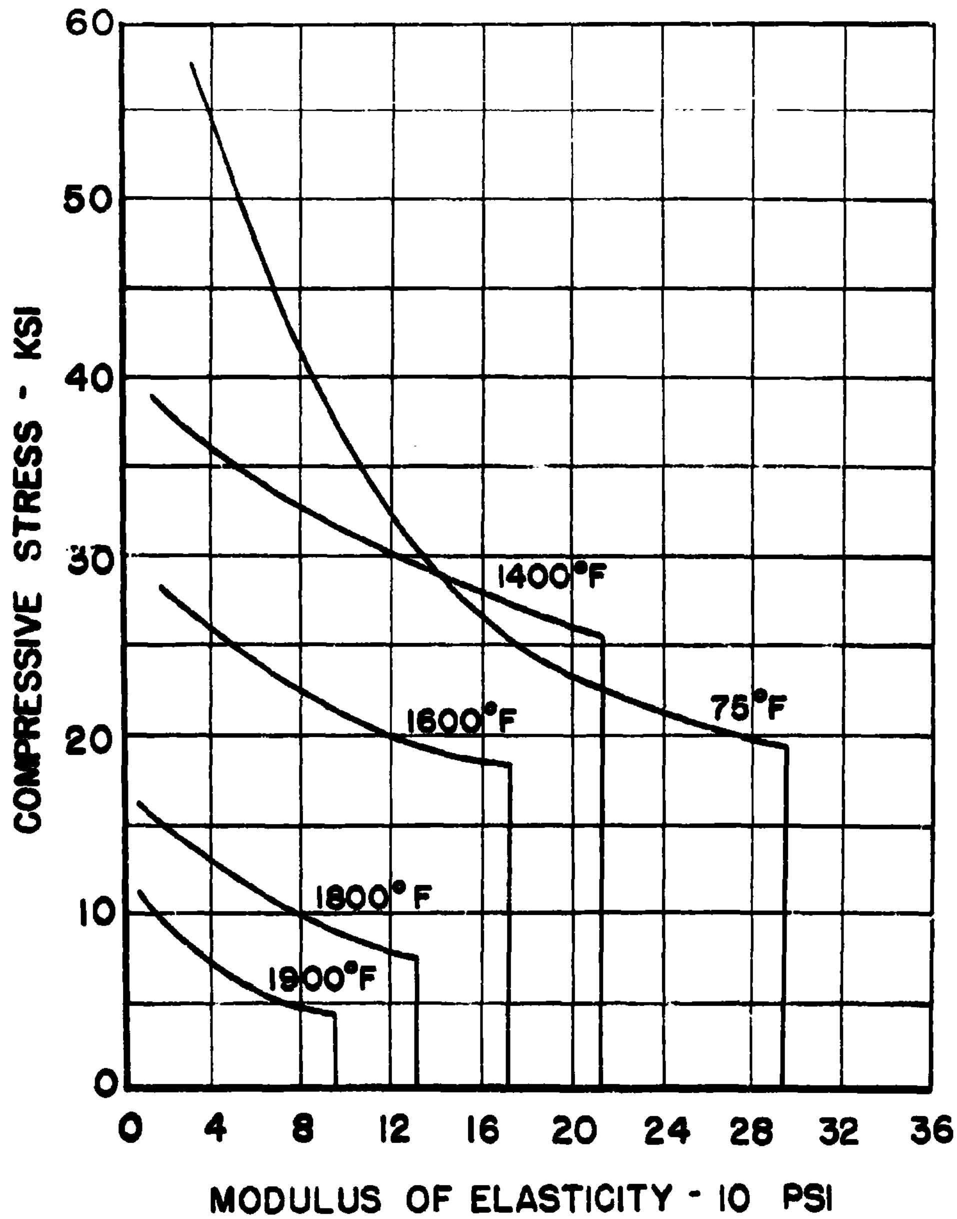


FIGURE 275. COMPRESSIVE TANGENT MODULUS CURVES OF N-155 EXPOSED 100 HOURS

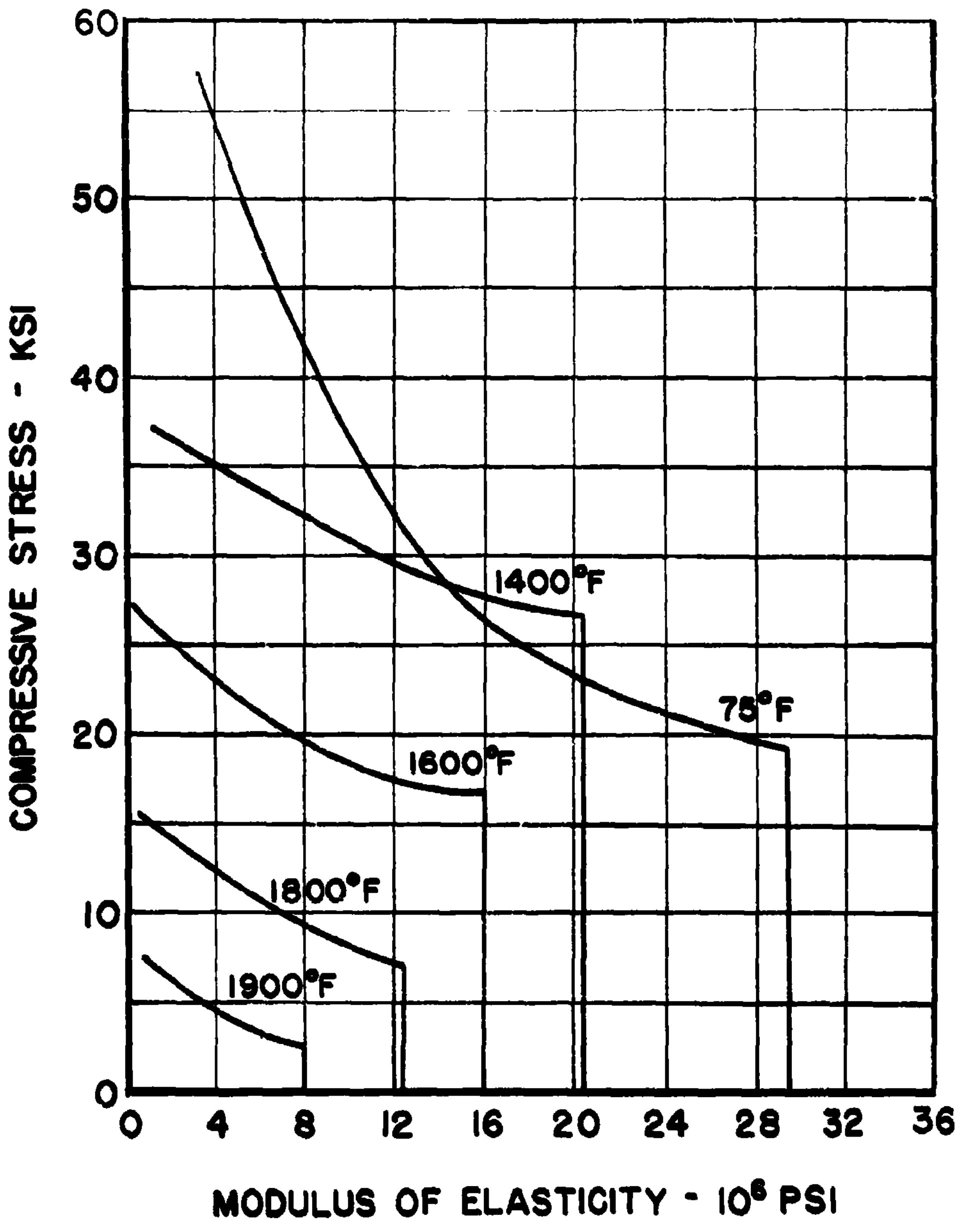


FIGURE 276. COMPRESSIVE TANGENT MODULUS CURVES OF N-155 EXPOSED 1000 HOURS

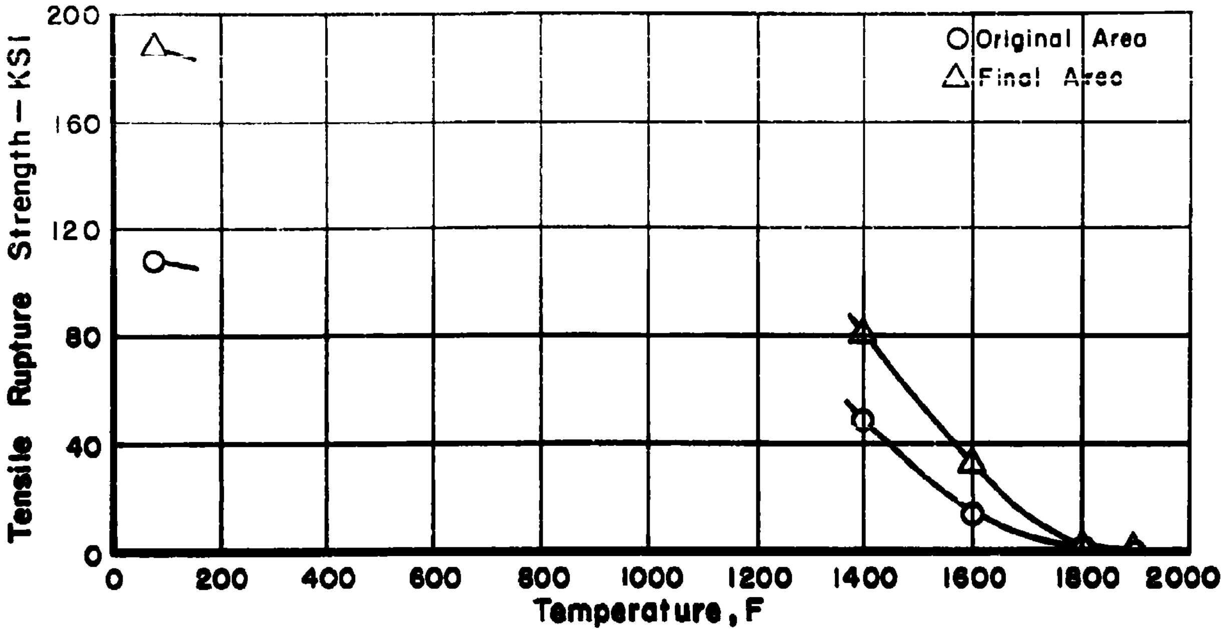


FIGURE 277. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF N-155 EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

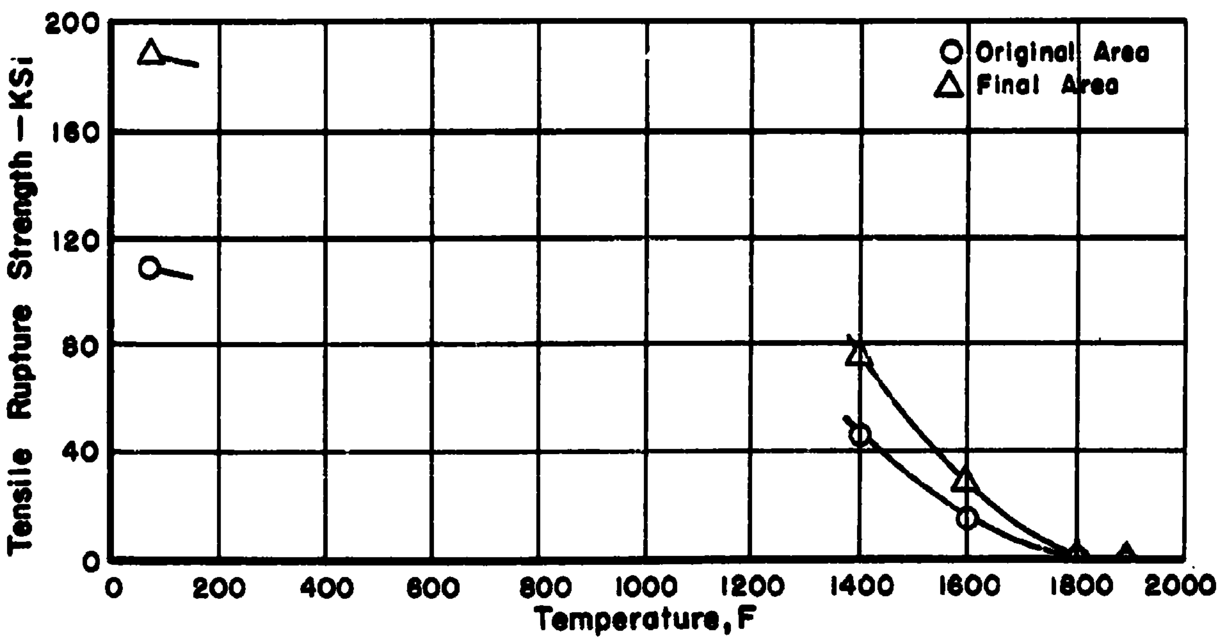


FIGURE 278. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF N-155 EXPOSED 10 HOURS, BASED ON ORIGINAL AND FINAL AREAS

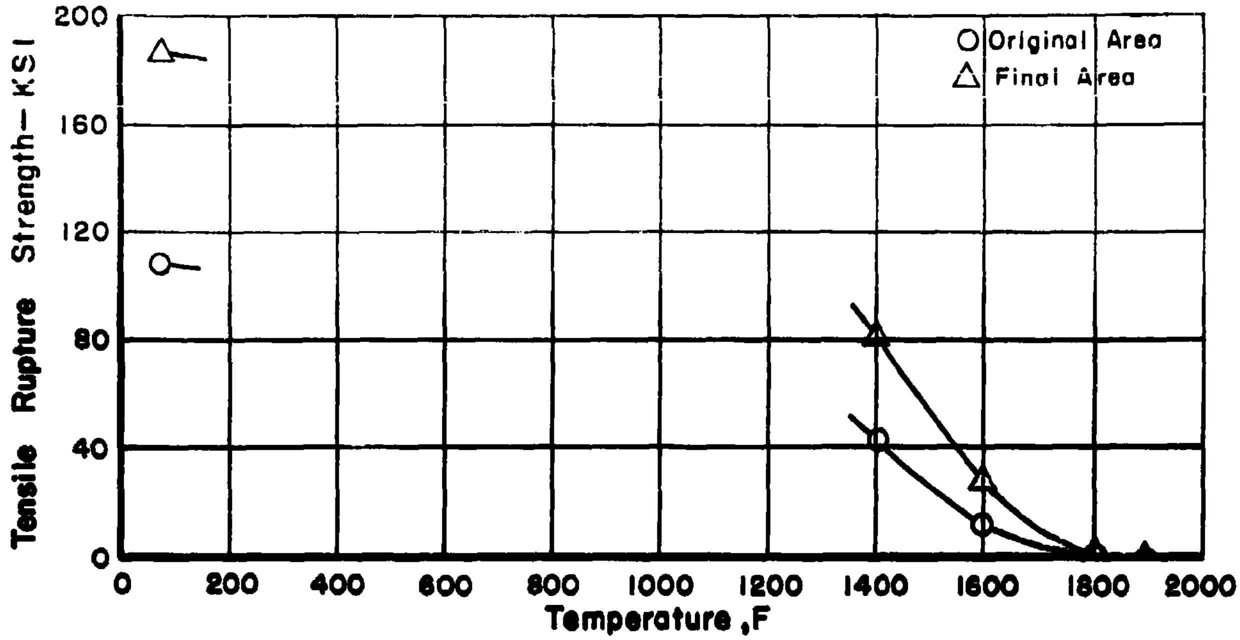


FIGURE 279. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF N-155 EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

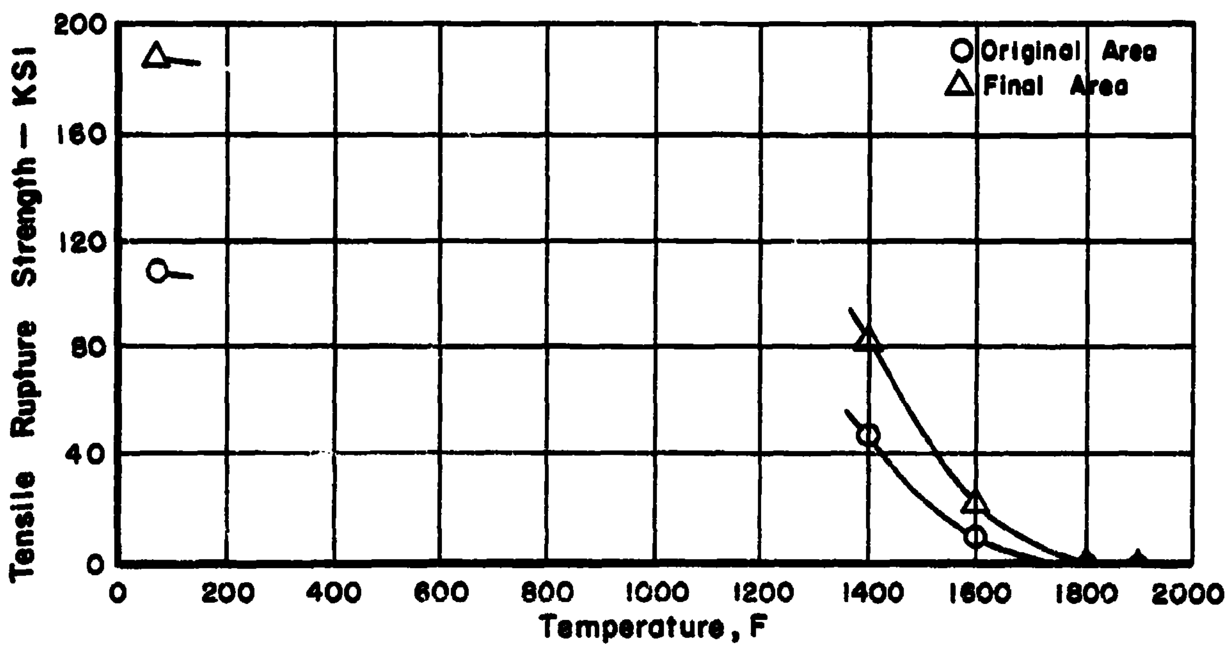


FIGURE 280. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF N-155 EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

APPENDIX V

## SUMMARY OF ROOM TEMPERATURE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL

**Form: 0.050 Inch Sheet**

**Condition: 60% Cold Reduced**

**Properties:**

| | | | | |
|---|---|---|---|---|
| Ultimate Tensile Strength | - | $F_{tu}$ | = | 272,150 psi |
| Tensile Yield Strength | - | $F_{ty}$ | = | 258,030 psi |
| Modulus of Elasticity | - | E | = | $25.56 \times 10^6$ psi |
| Percent Elongation in 2 inches | | | = | 3.1 |
| Notched Tensile Strength | - | $F_{tu}$ | = | 283,530 psi |
| Compressive Yield Strength | - | $F_{cy}$ | = | 206,470 psi |
| Compressive Modulus of Elasticity | - | $E_c$ | = | $26.87 \times 10^6$ psi |
| Ultimate Bearing Strength | | | | |
| (e/D = 1.5) | - | $F_{bru}$ | = | 375,580 psi |
| (e/D = 2.0) | - | $F_{bru}$ | = | 472,020 psi |
| Bearing Yield Strength | | | | |
| (e/D = 1.5) | - | $F_{bry}$ | = | 326,560 psi |
| (e/D = 2.0) | - | $F_{bry}$ | = | 423,960 psi |
| Ultimate Shear Strength | - | $F_{su}$ | = | 89,100 psi |

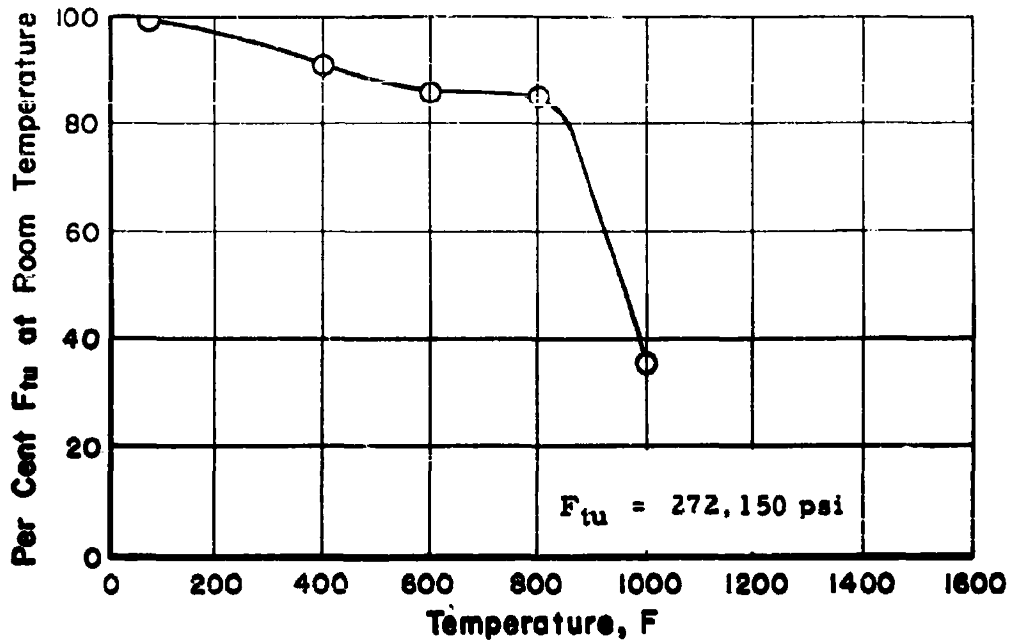


FIGURE 281. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

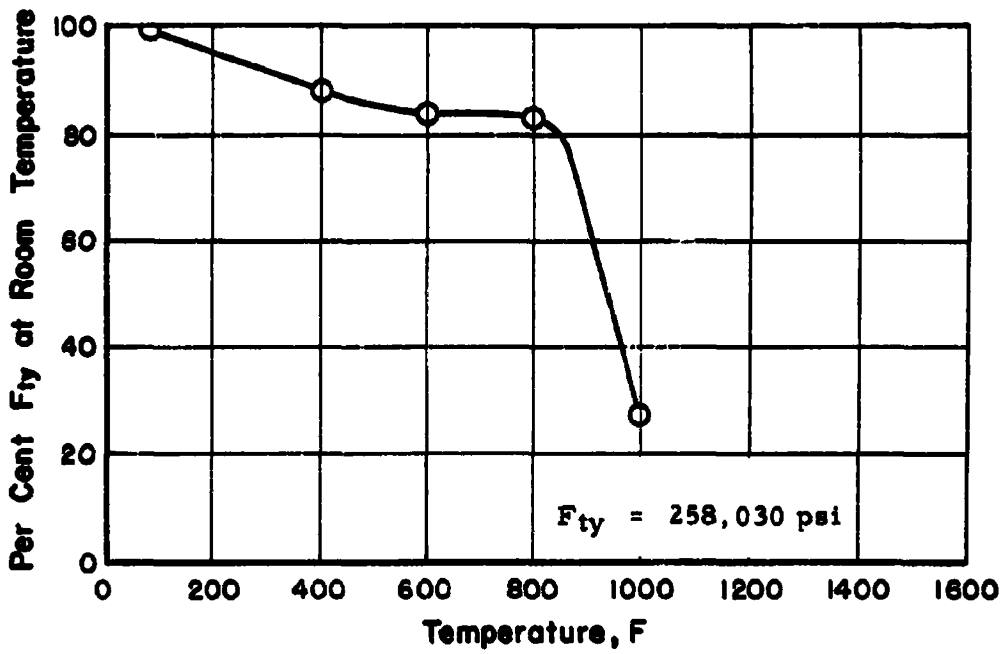


FIGURE 282. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

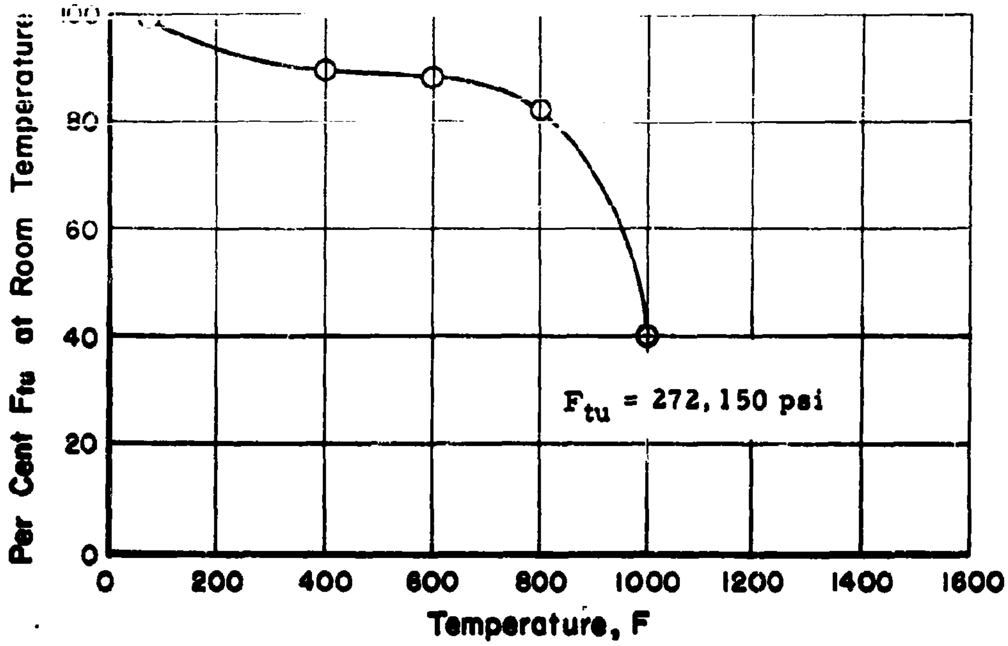


FIGURE 283. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

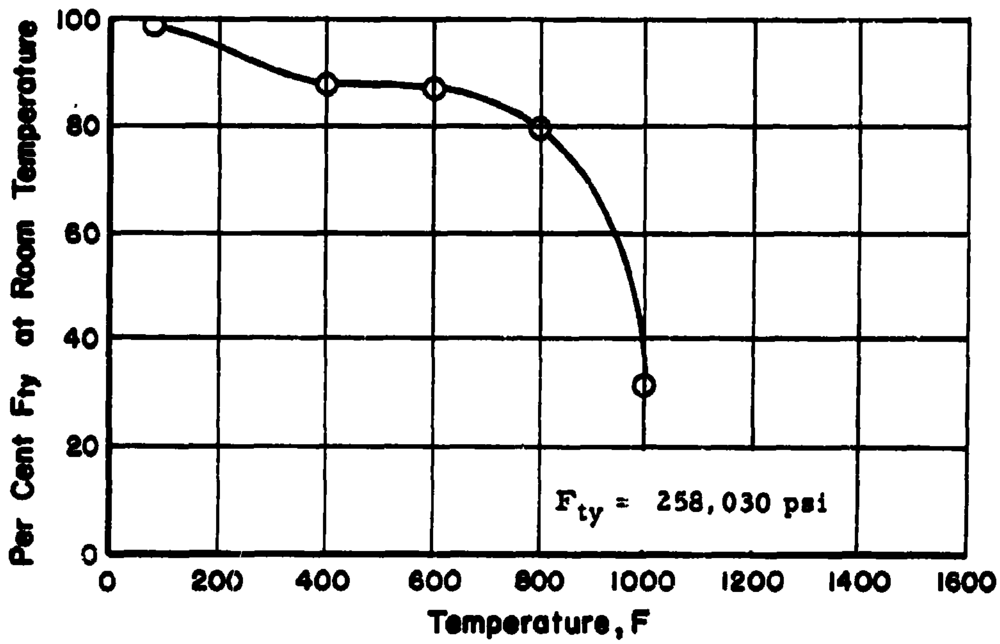


FIGURE 284. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

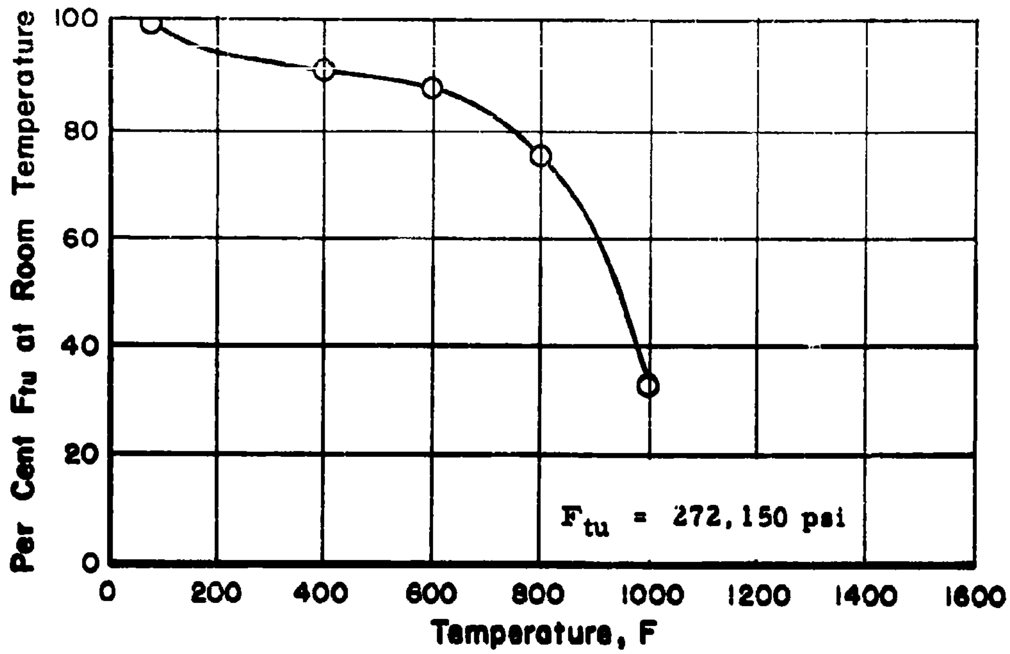


FIGURE 285. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

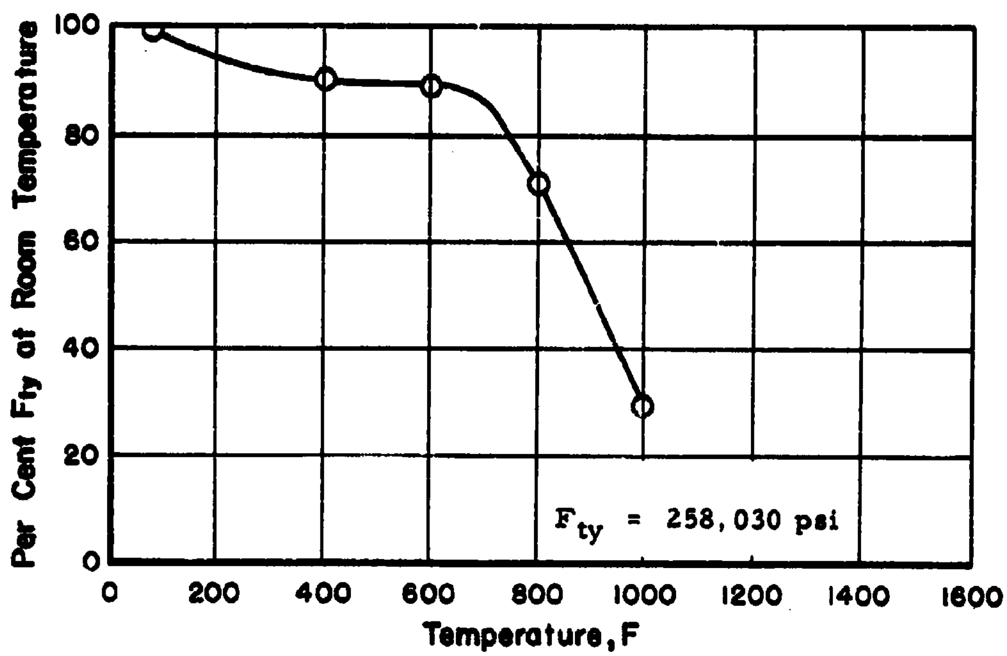


FIGURE 286. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

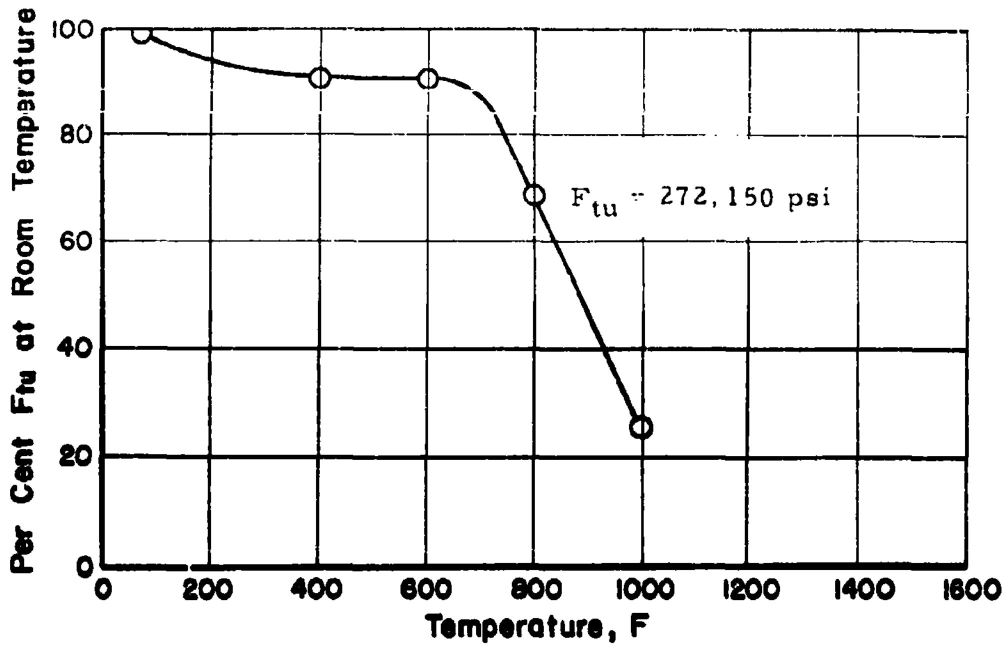


FIGURE 287. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

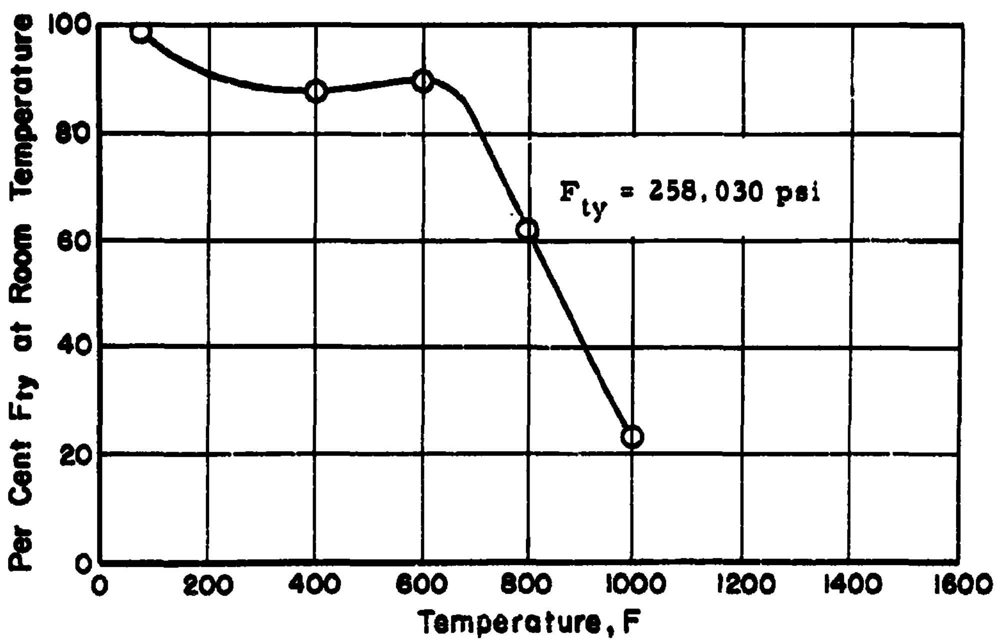


FIGURE 288. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

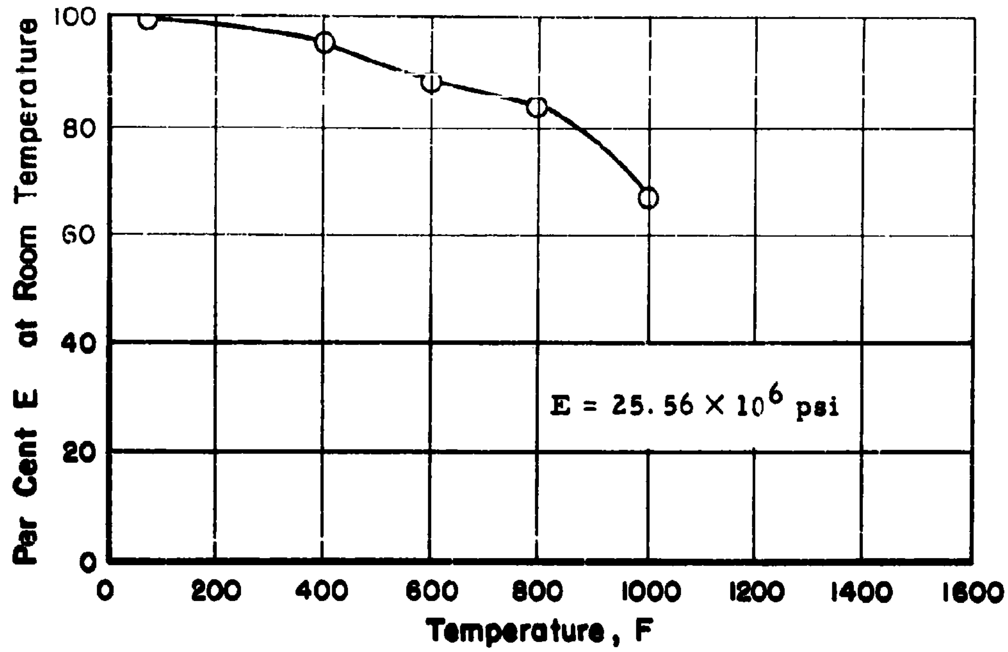


FIGURE 289. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

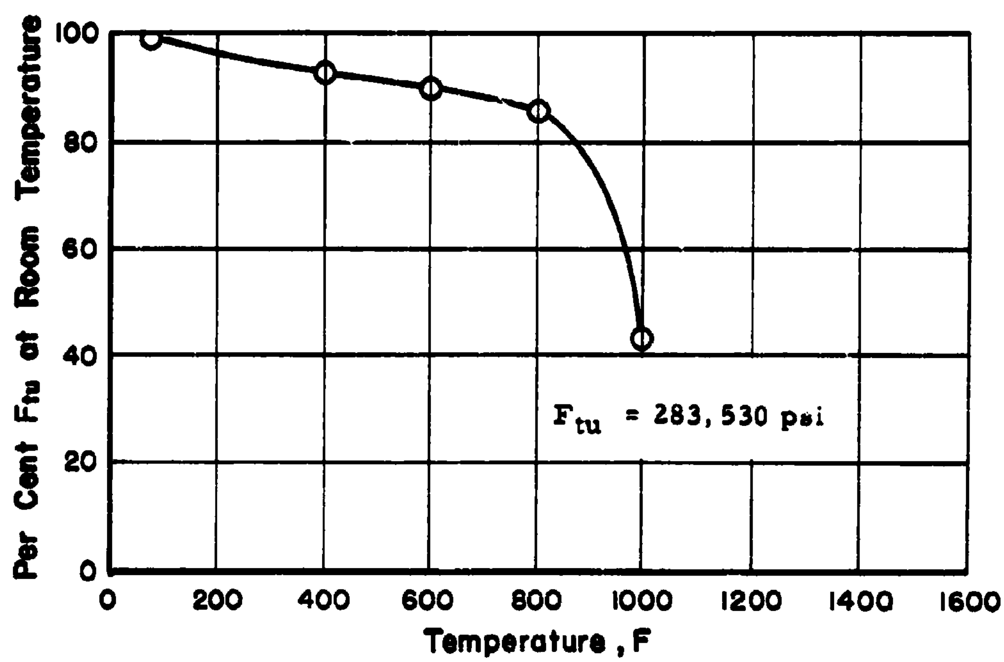


FIGURE 290. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

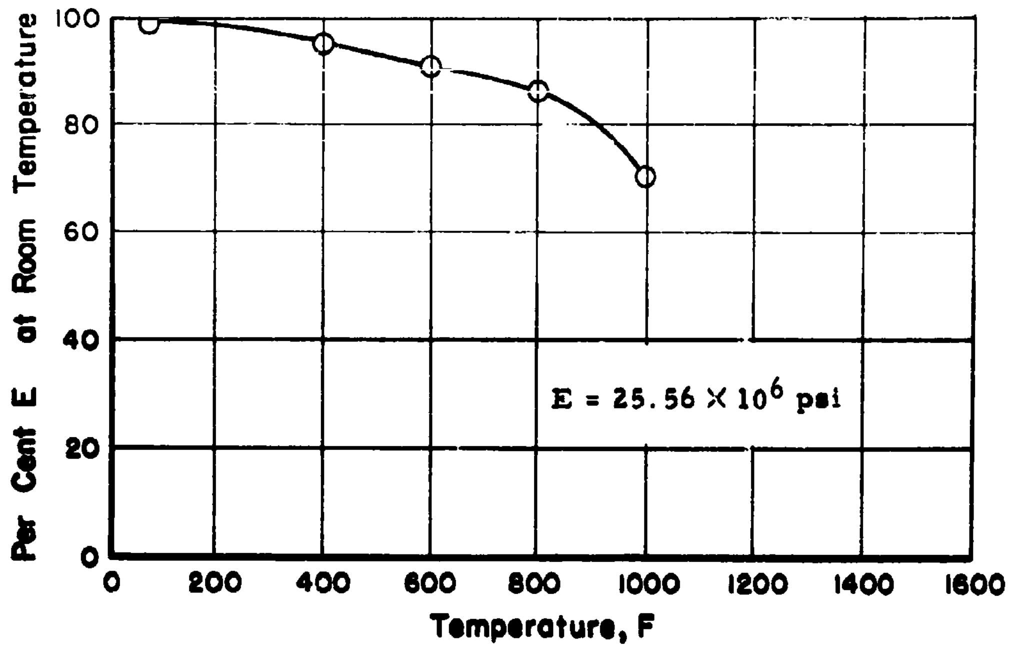


FIGURE 291. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

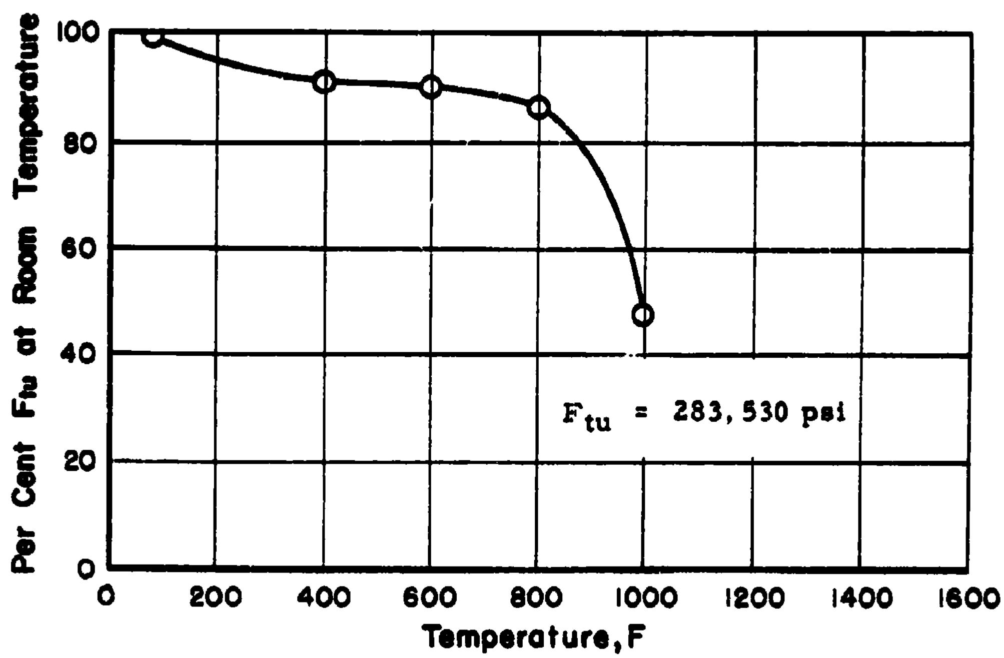


FIGURE 292. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

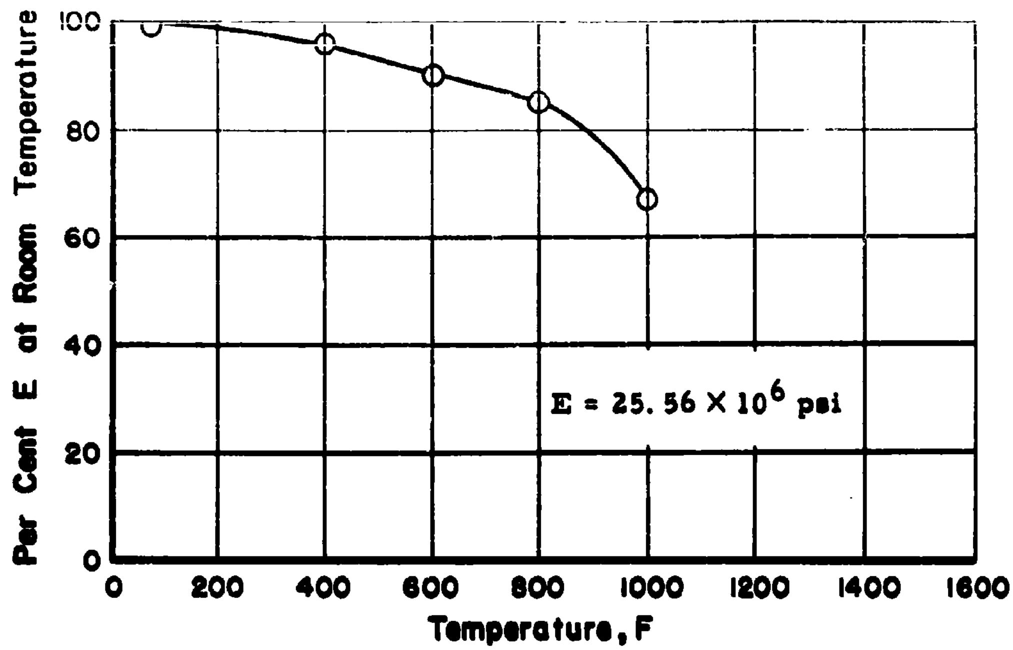


FIGURE 293. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

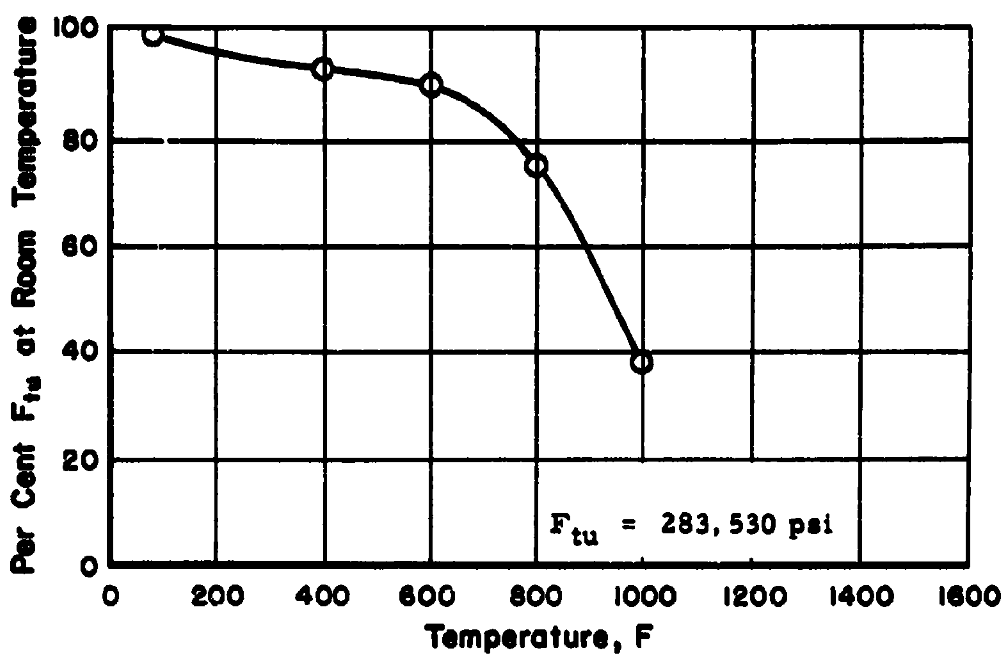


FIGURE 294. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

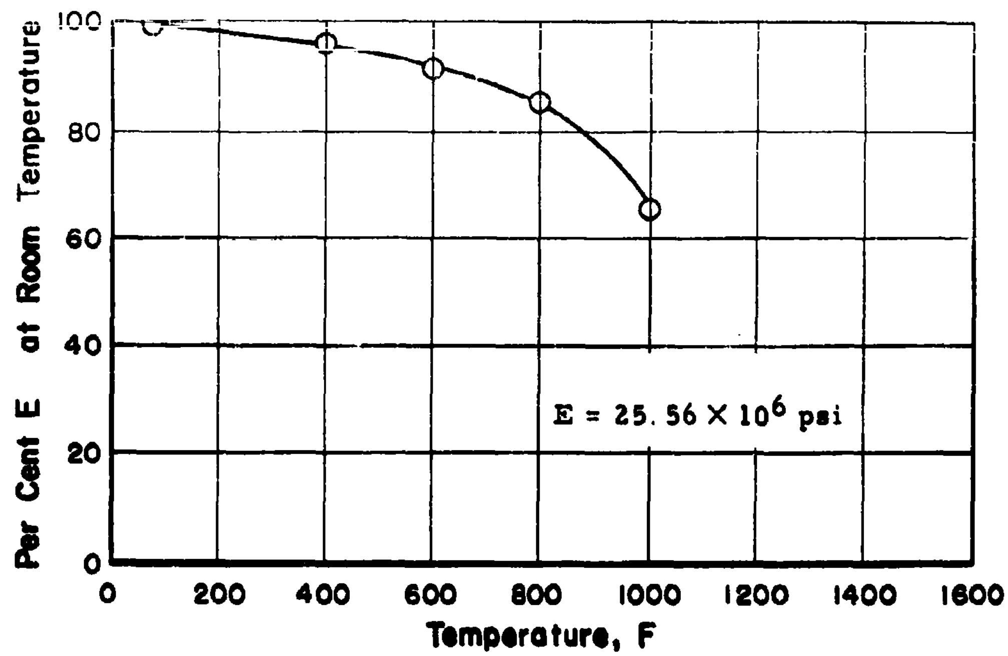


FIGURE 295. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

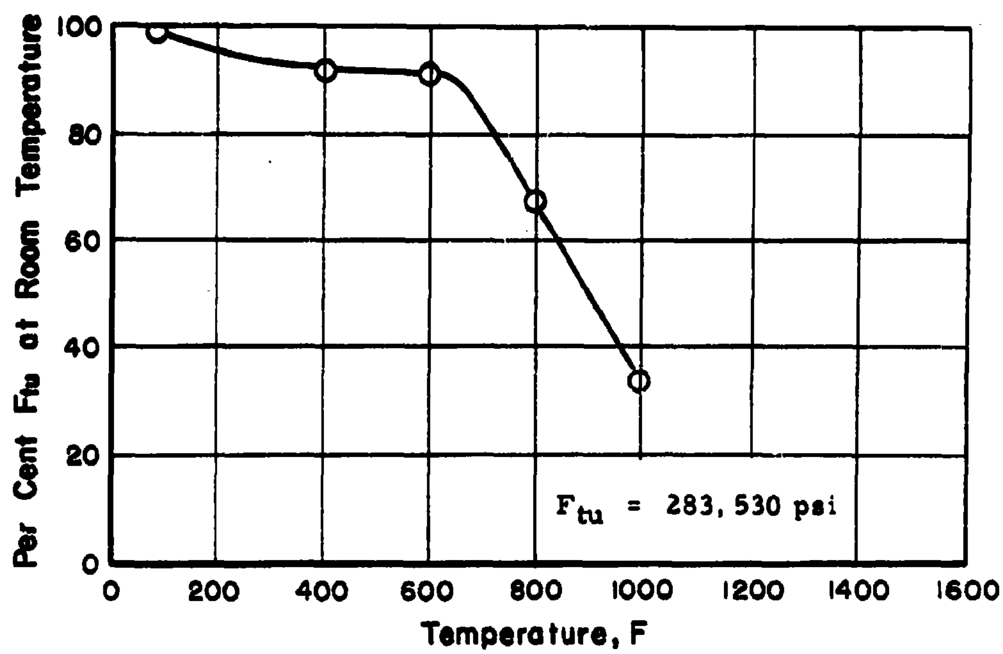


FIGURE 296. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

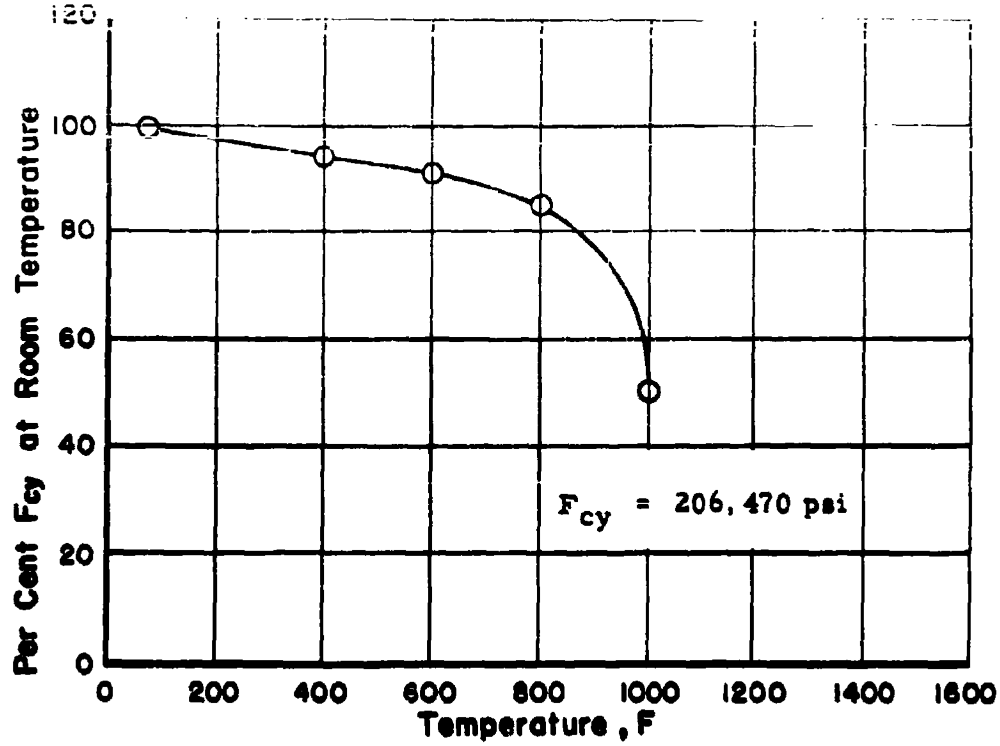


FIGURE 297. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

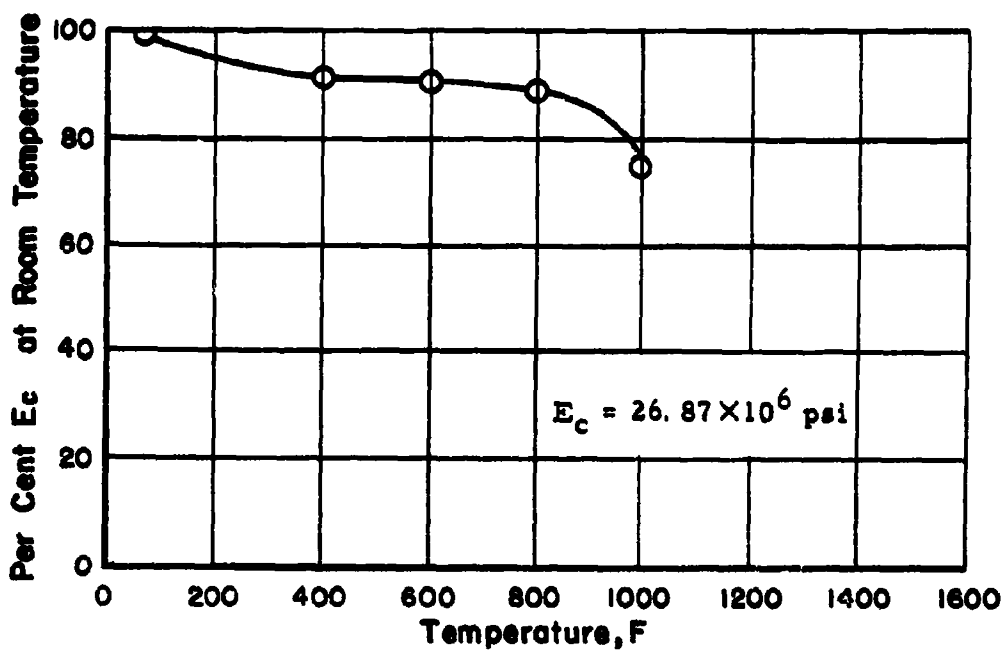


FIGURE 298. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

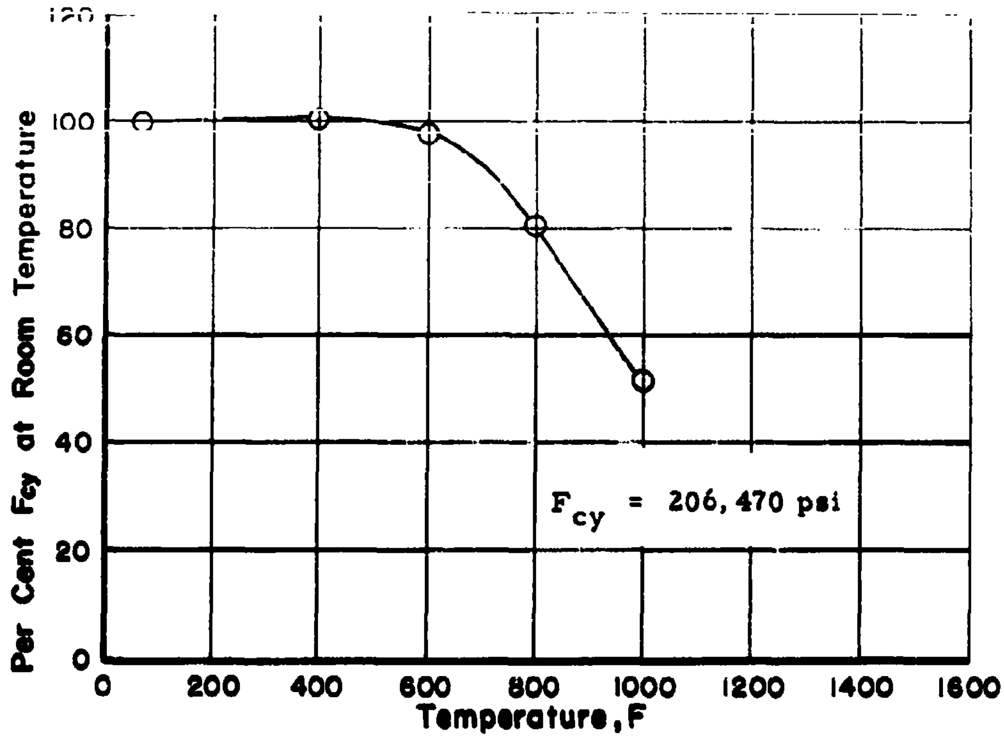


FIGURE 299. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

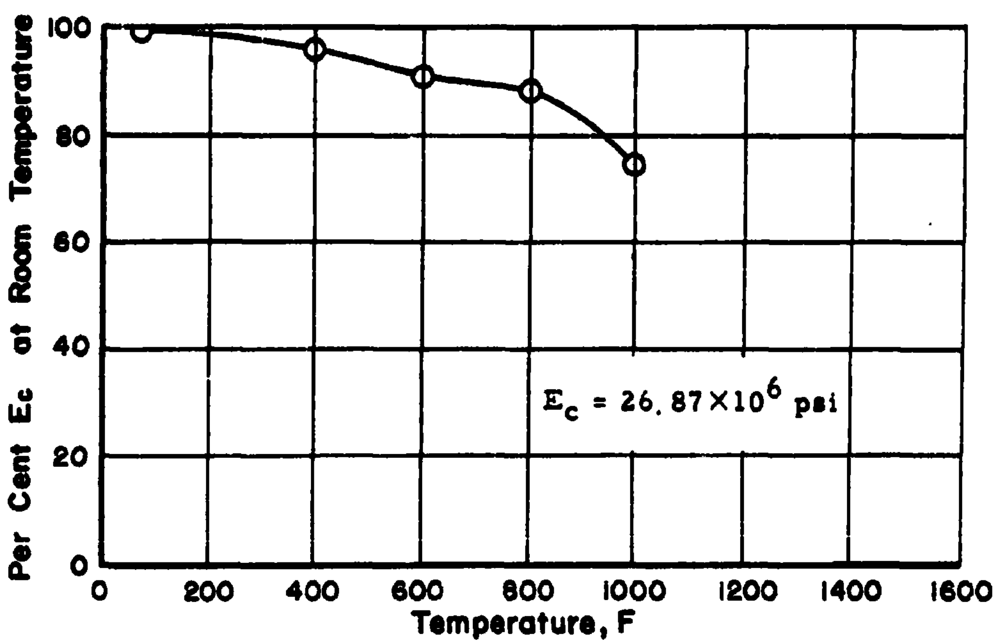


FIGURE 300. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

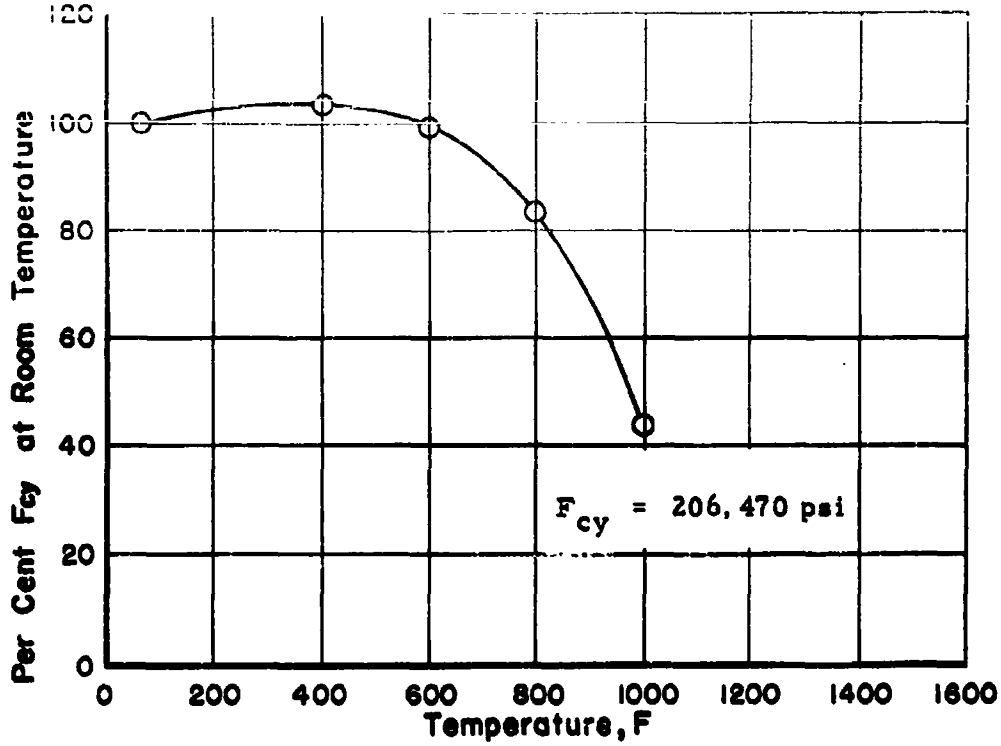


FIGURE 301. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

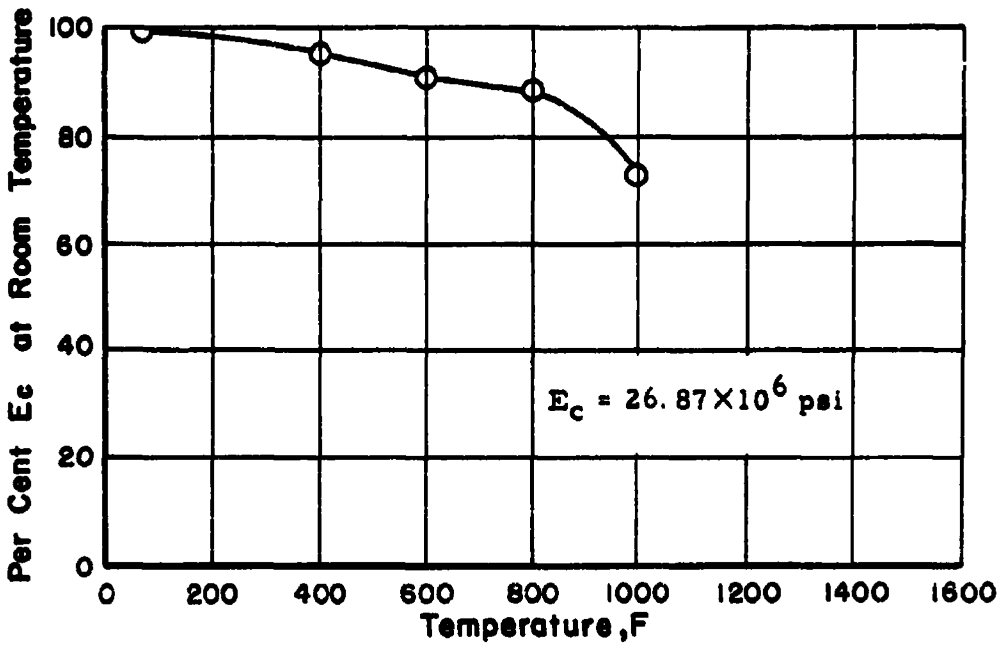


FIGURE 302. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

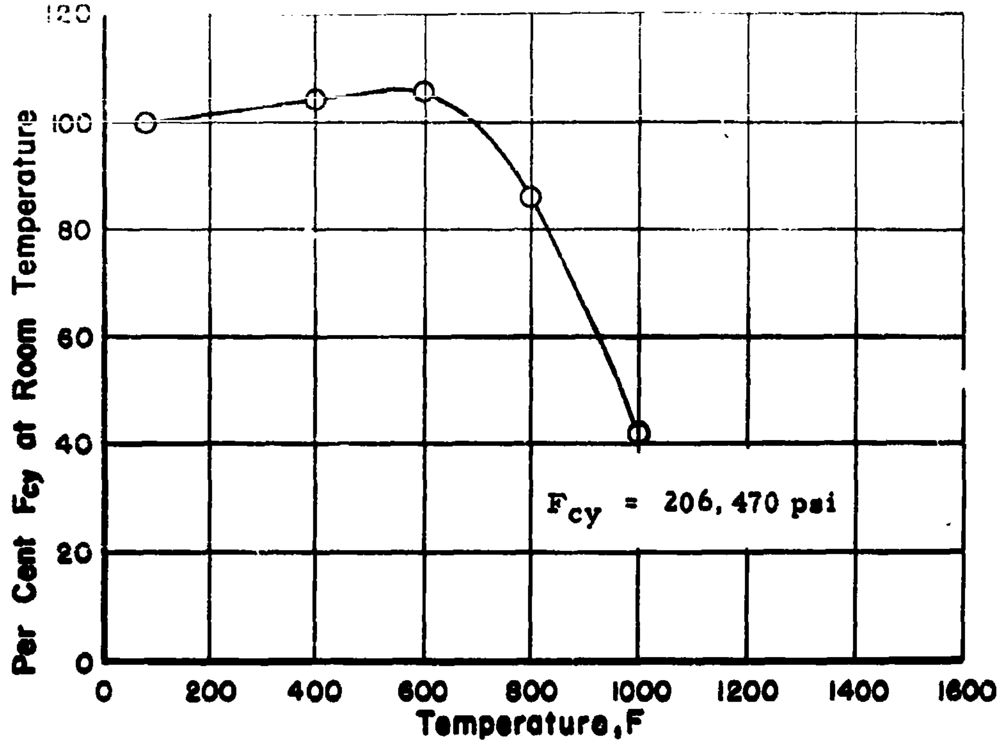


FIGURE 303. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

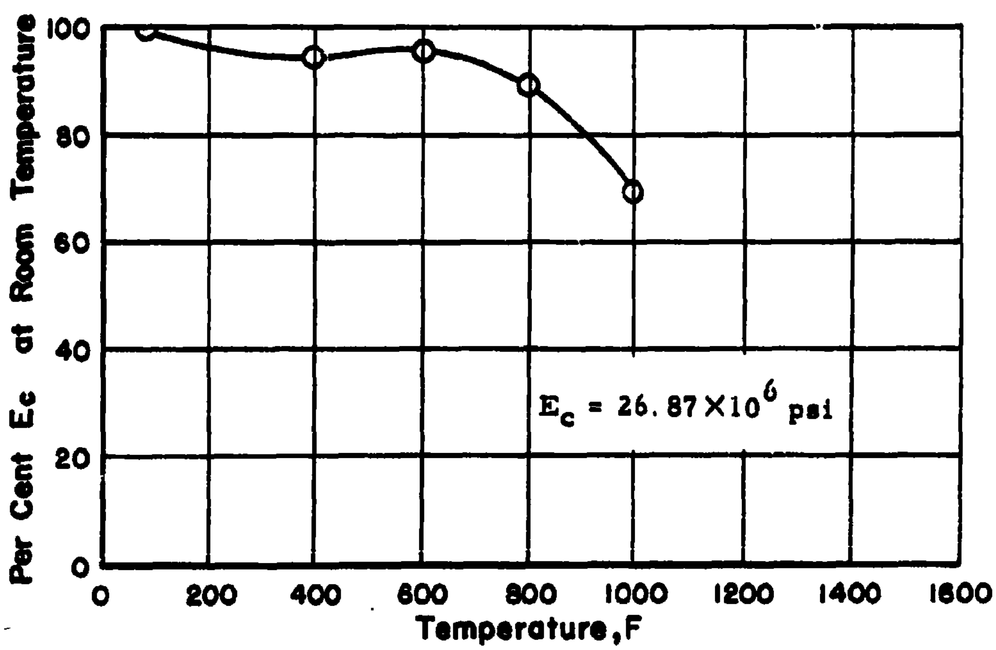


FIGURE 304. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

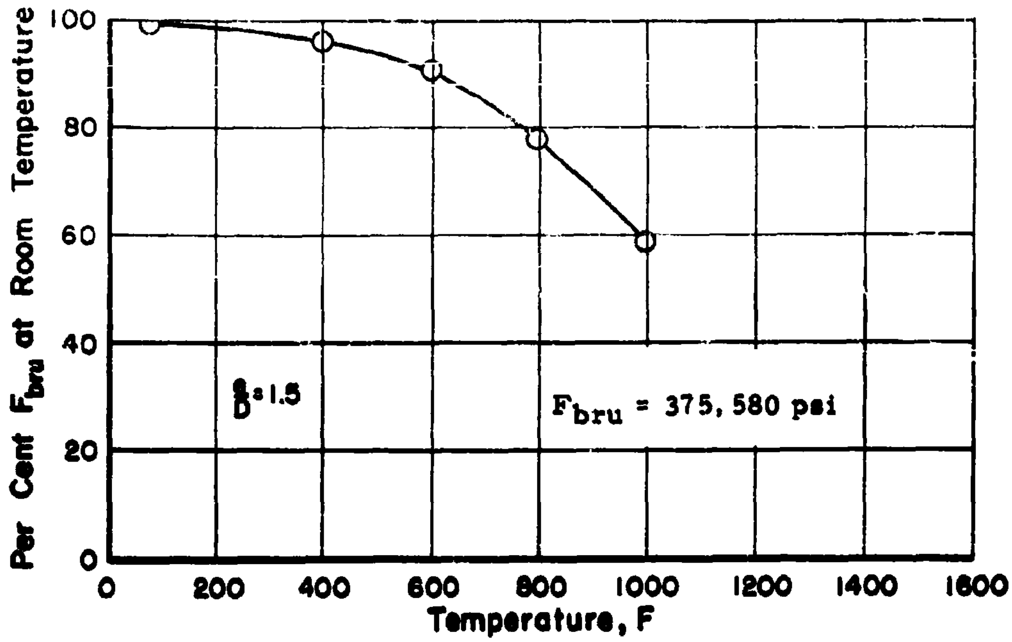


FIGURE 305. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

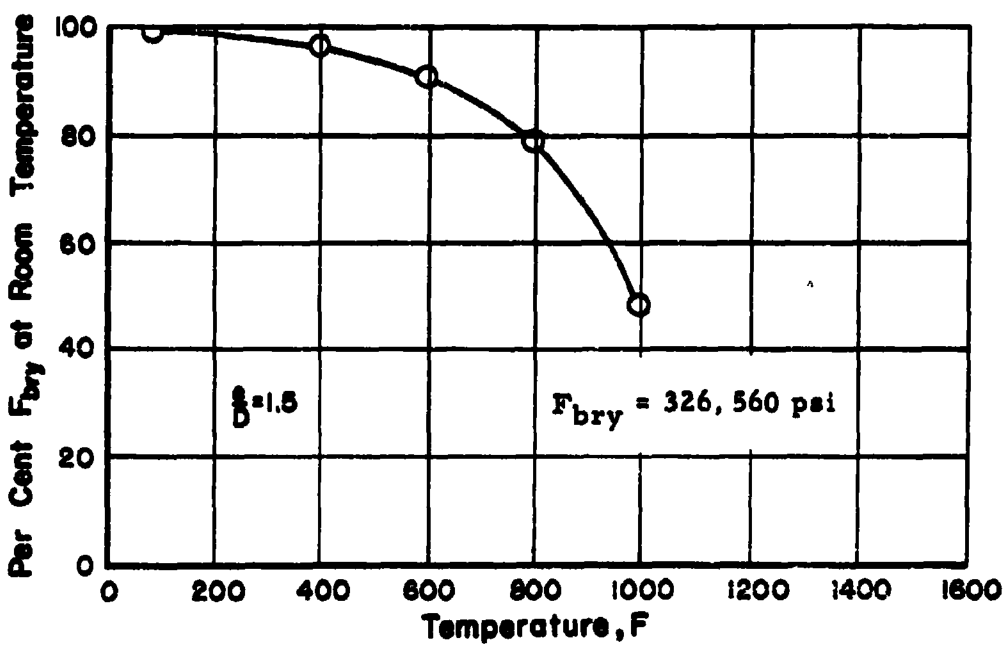


FIGURE 306. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

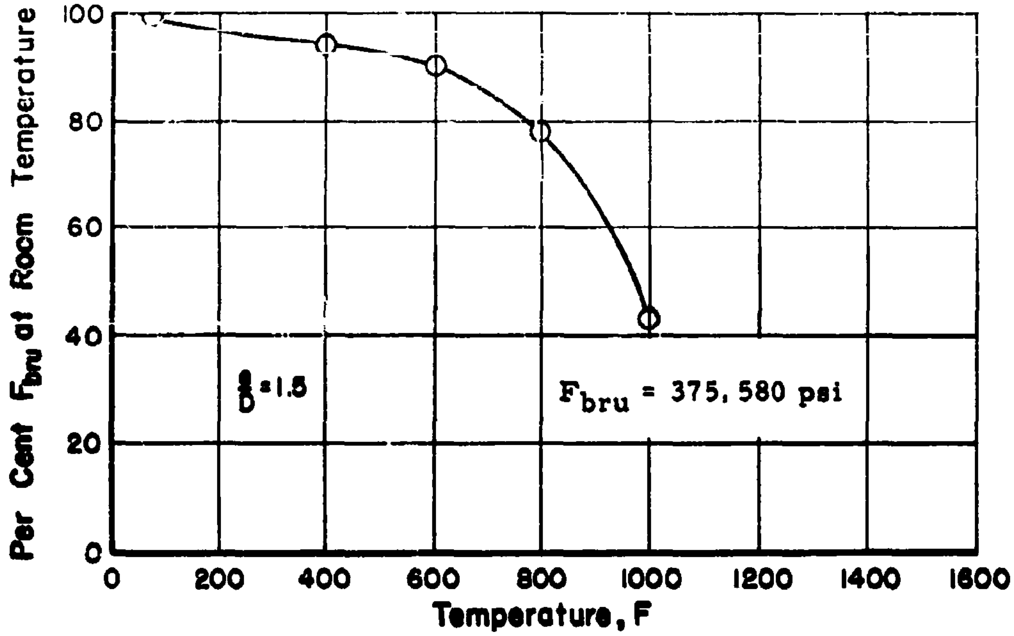


FIGURE 307. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

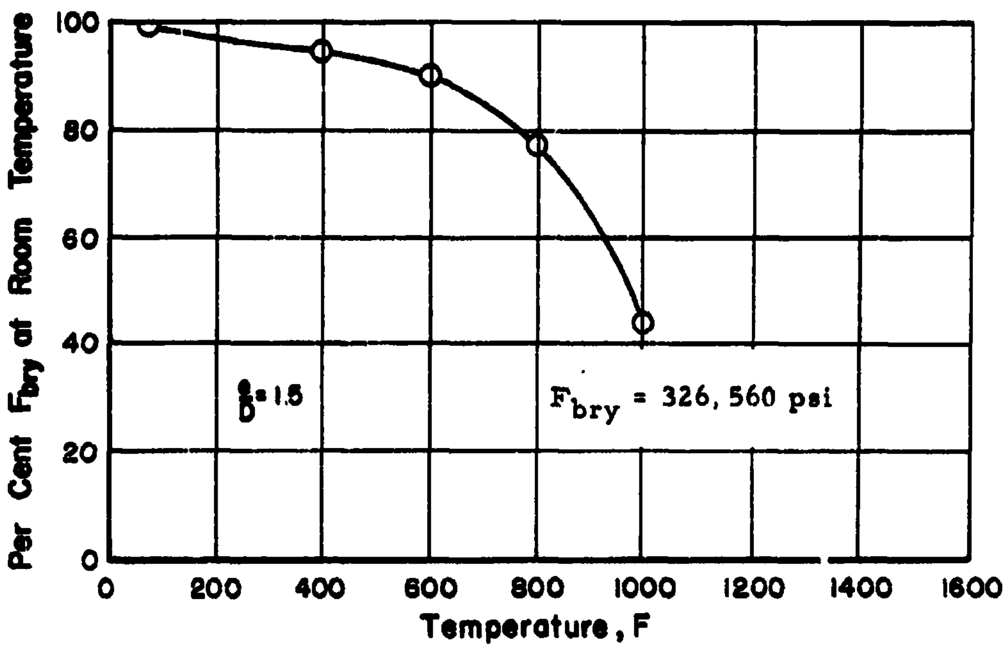


FIGURE 308. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

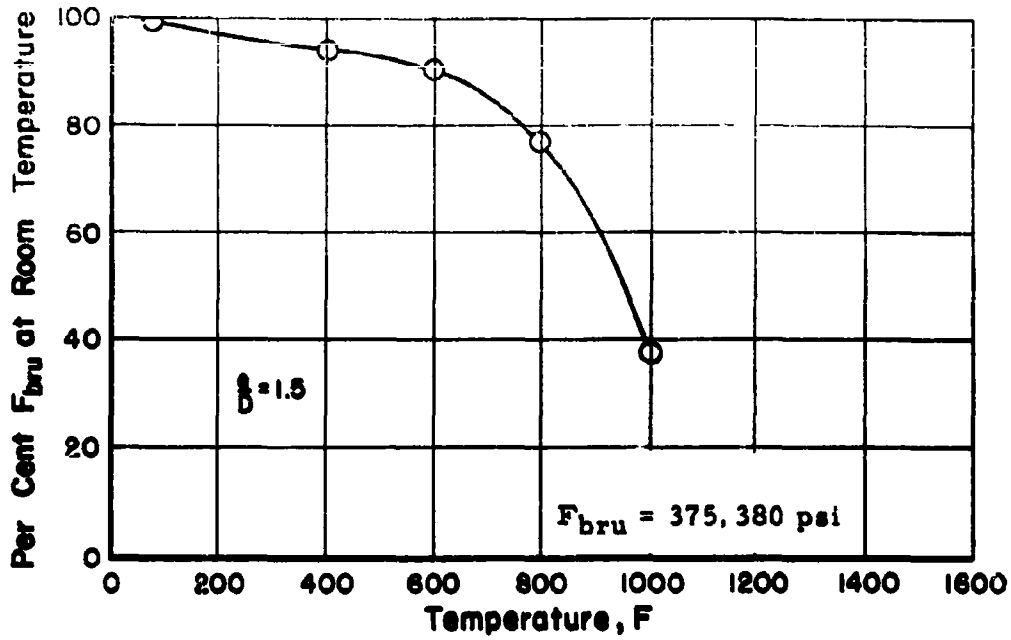


FIGURE 309. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

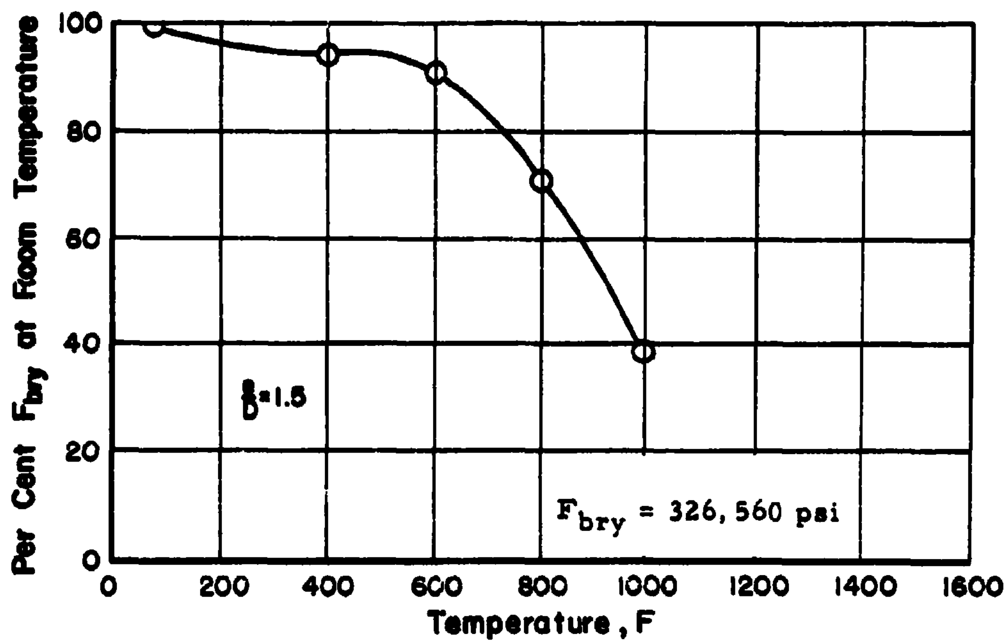


FIGURE 310. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

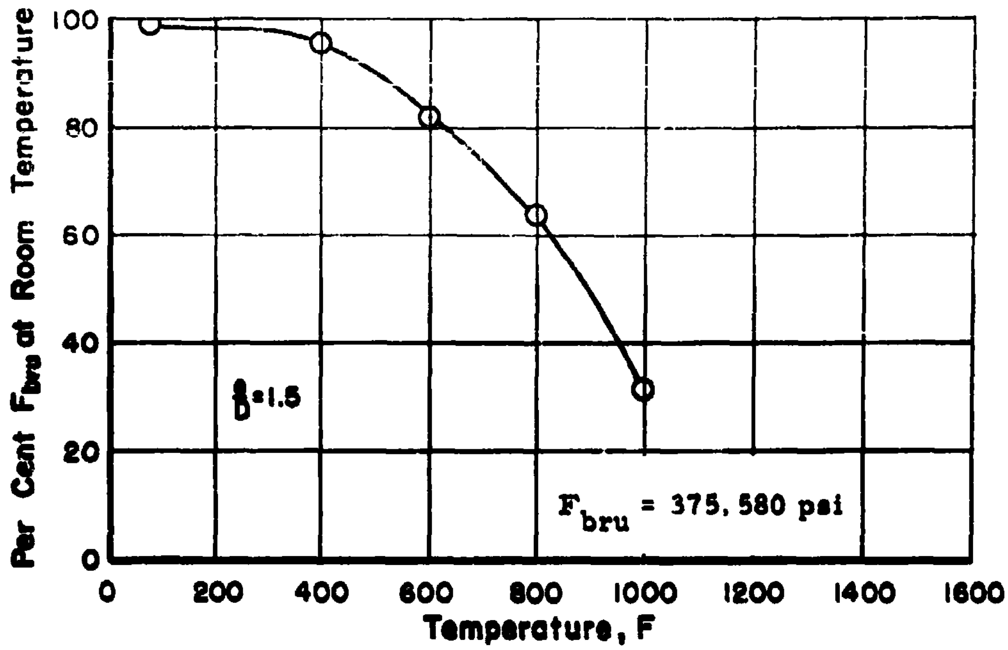


FIGURE 311. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

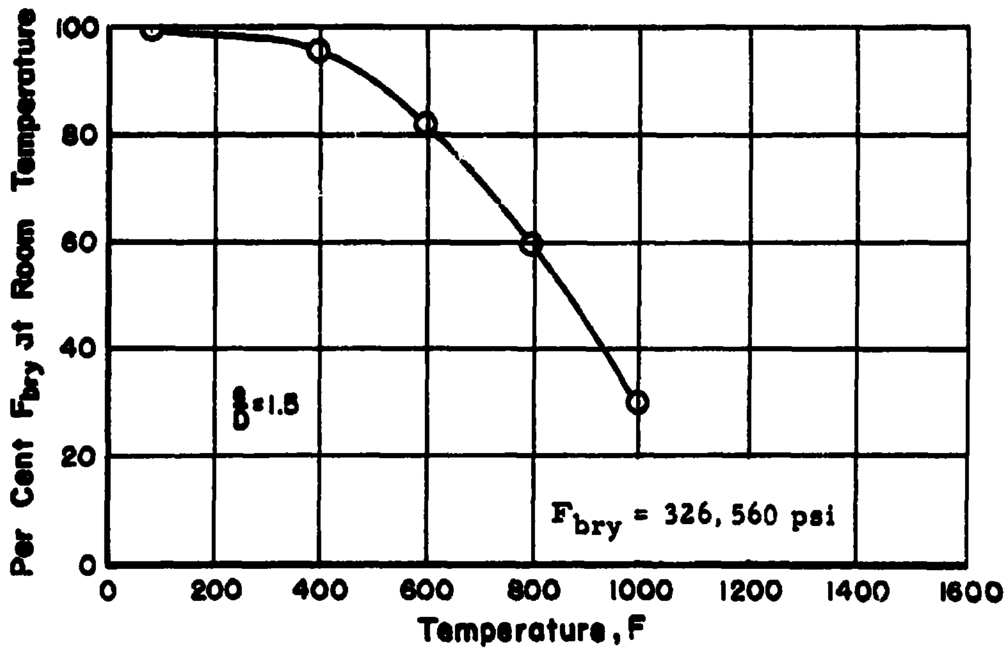


FIGURE 312. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

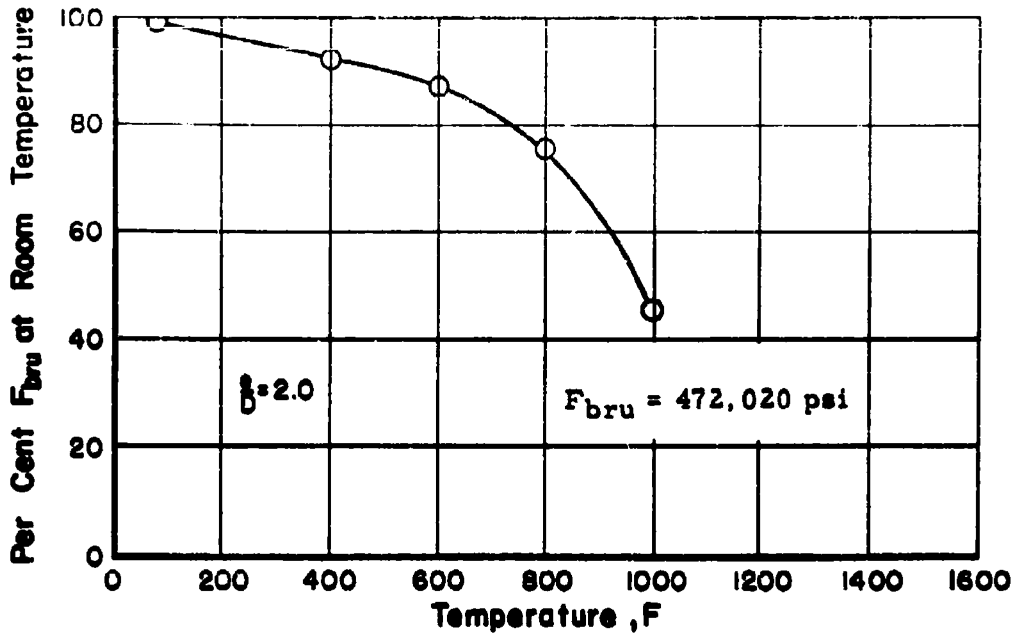


FIGURE 313. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

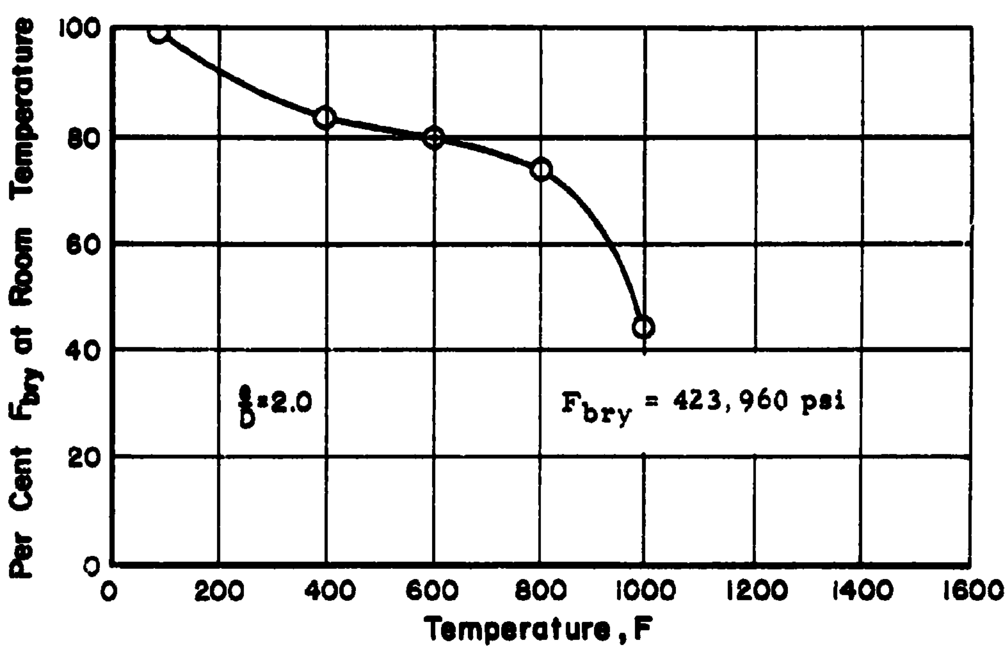


FIGURE 314. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

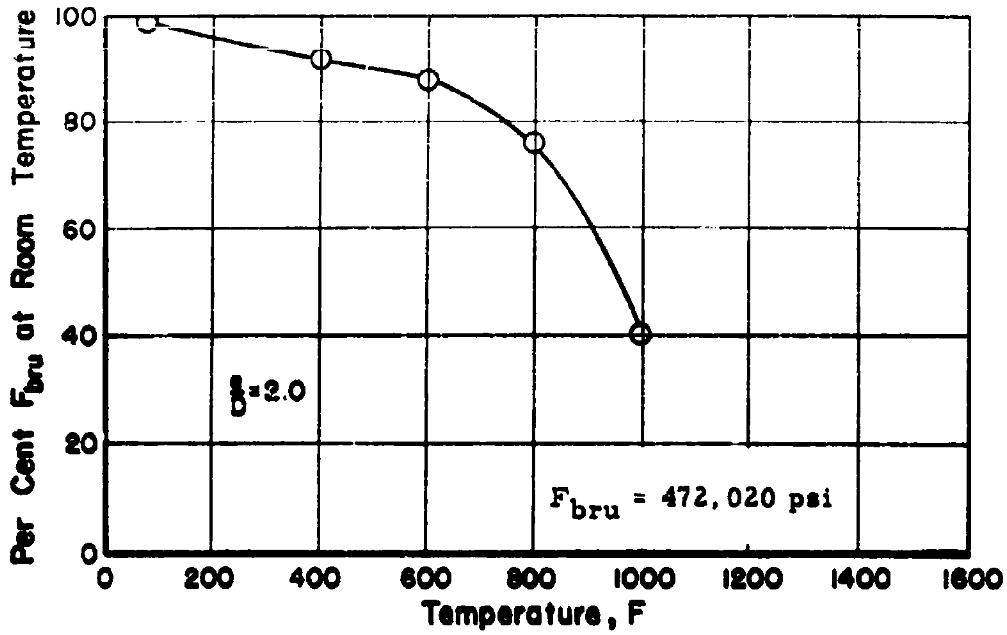


FIGURE 315. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

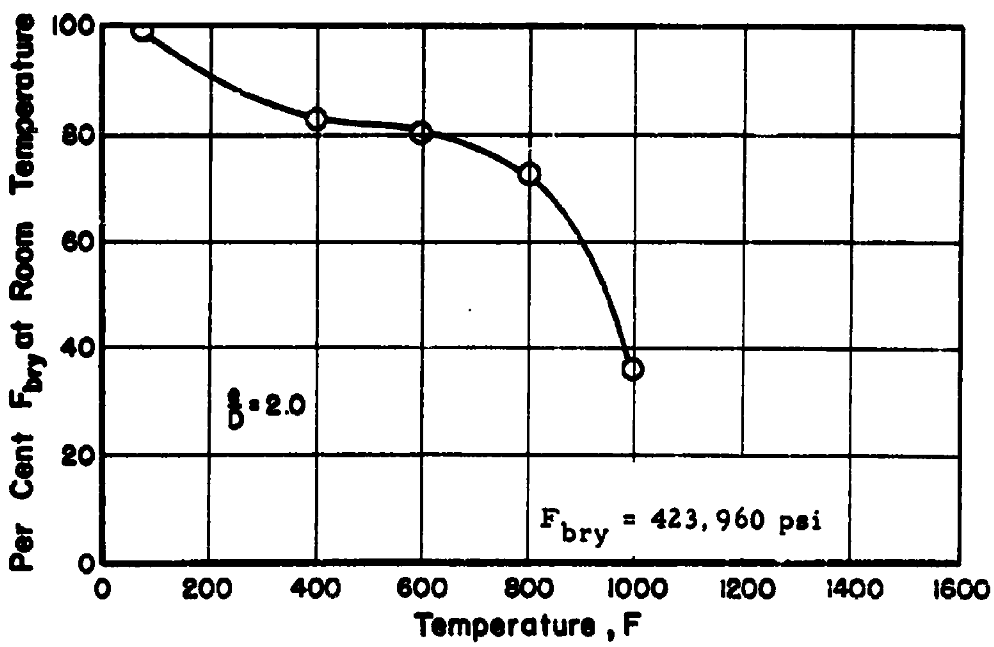


FIGURE 316. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

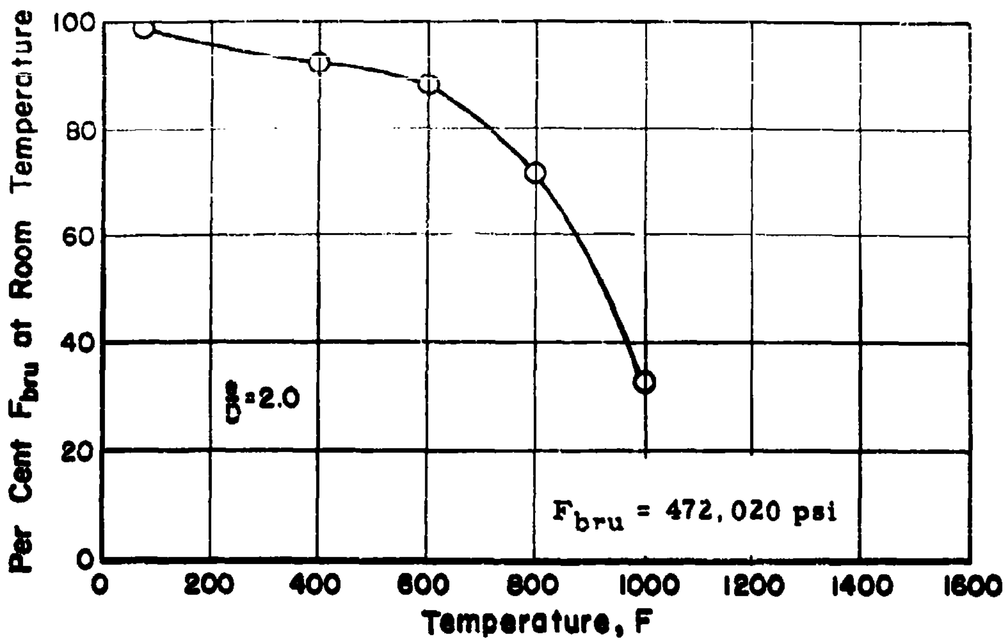


FIGURE 317. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

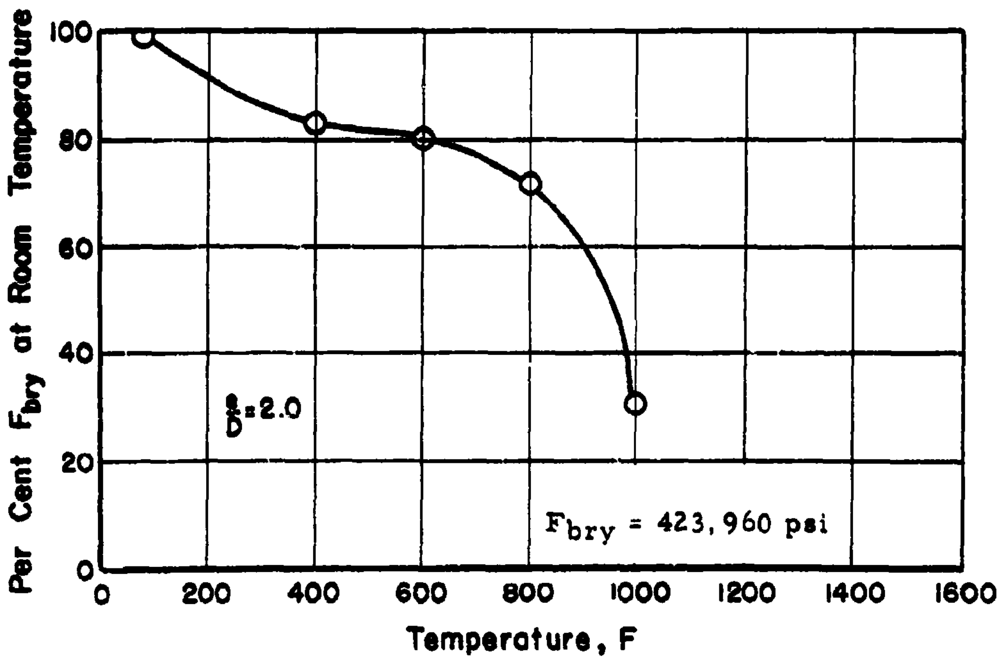


FIGURE 318. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

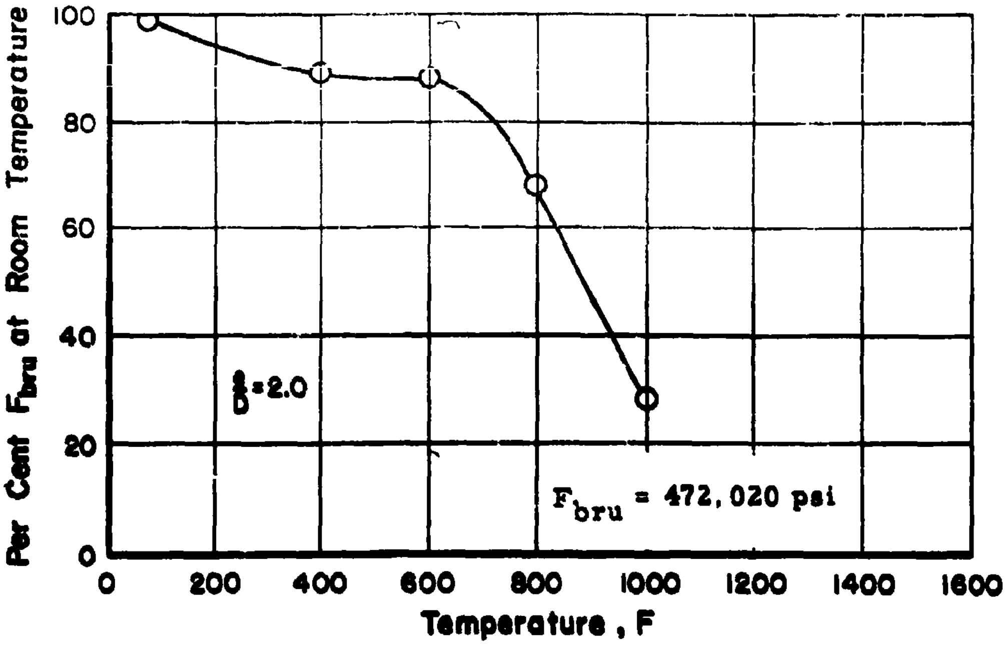


FIGURE 319. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

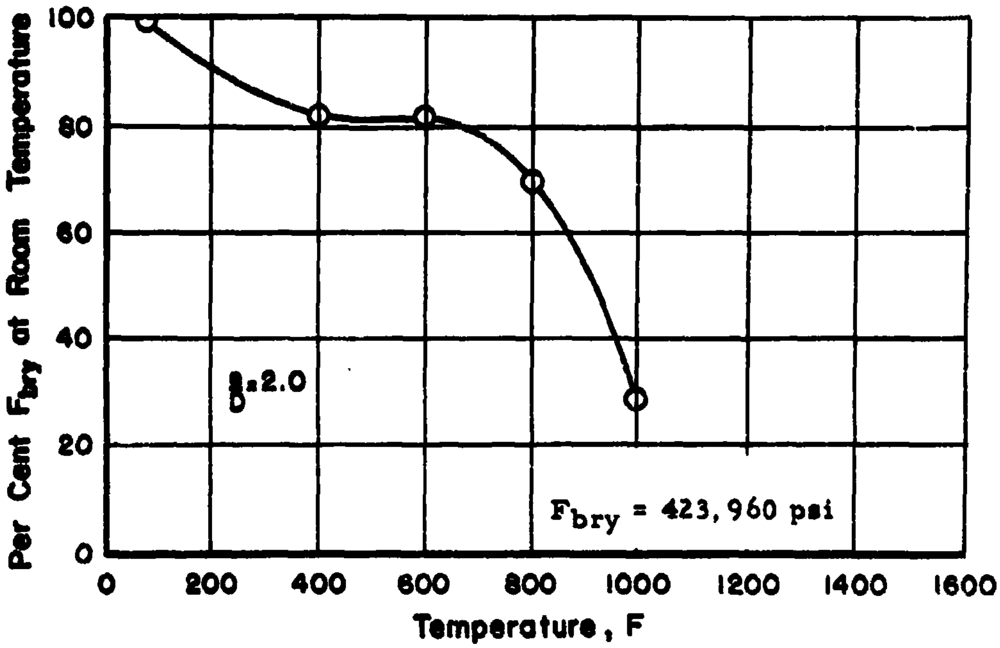


FIGURE 320. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

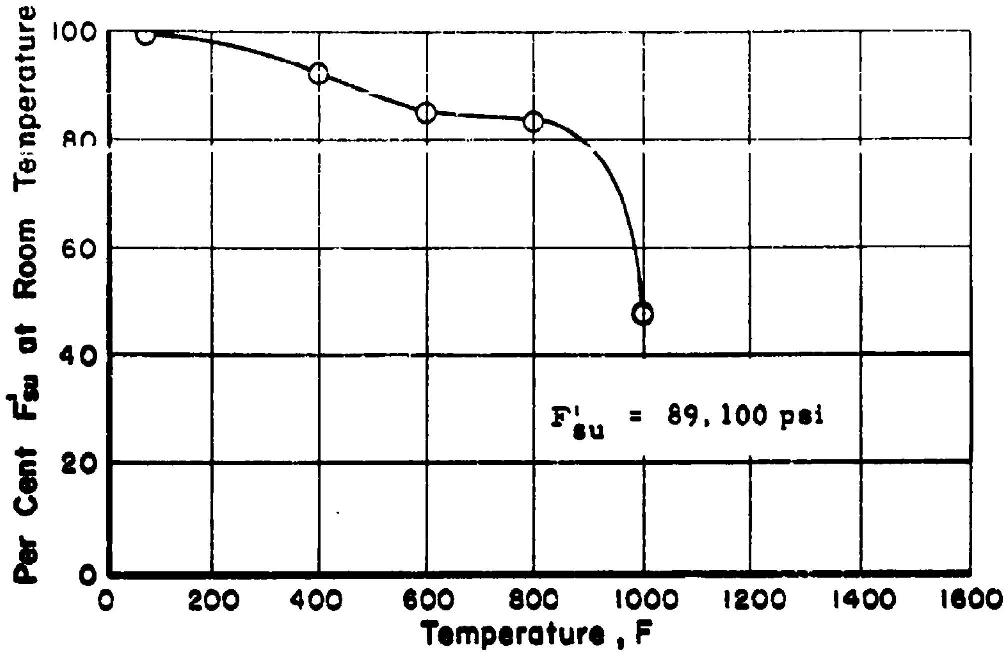


FIGURE 321. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

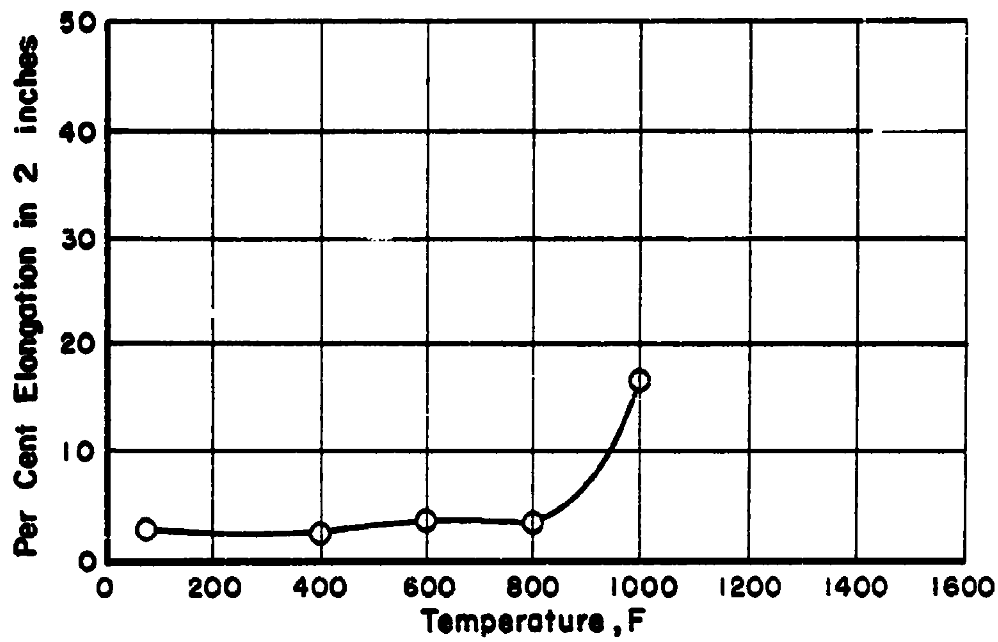


FIGURE 322. EFFECT OF TEMPERATURE ON ELONGATION OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

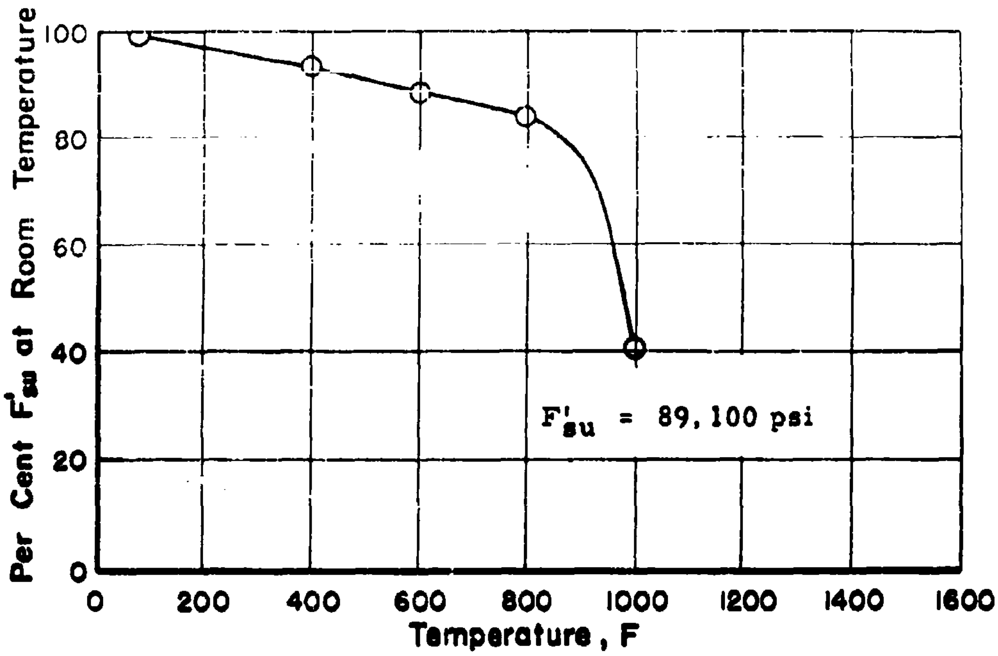


FIGURE 323. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

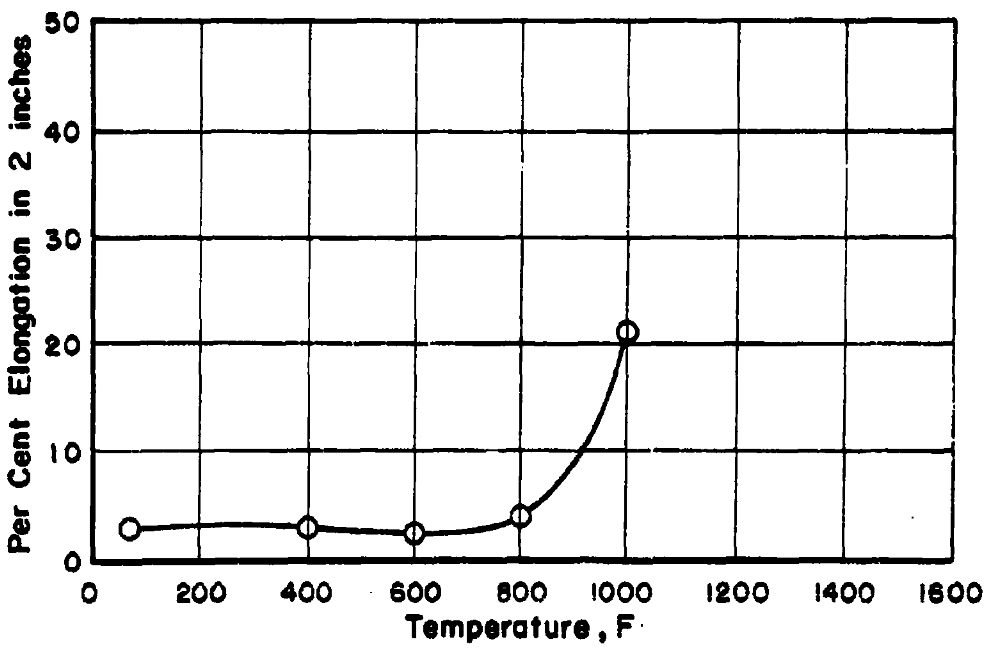


FIGURE 324. EFFECT OF TEMPERATURE ON ELONGATION OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

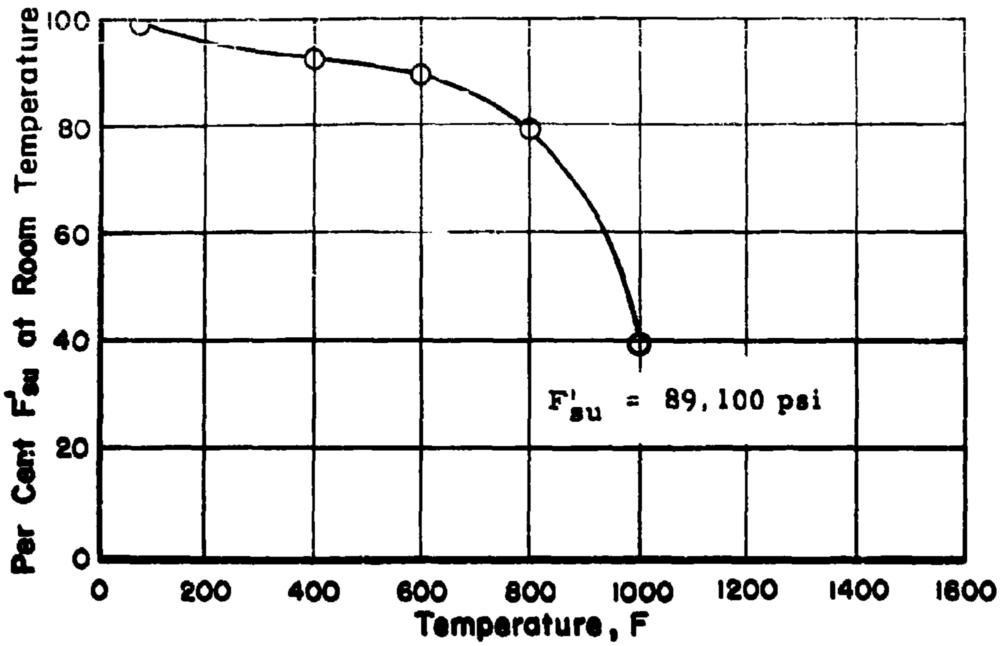


FIGURE 325. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

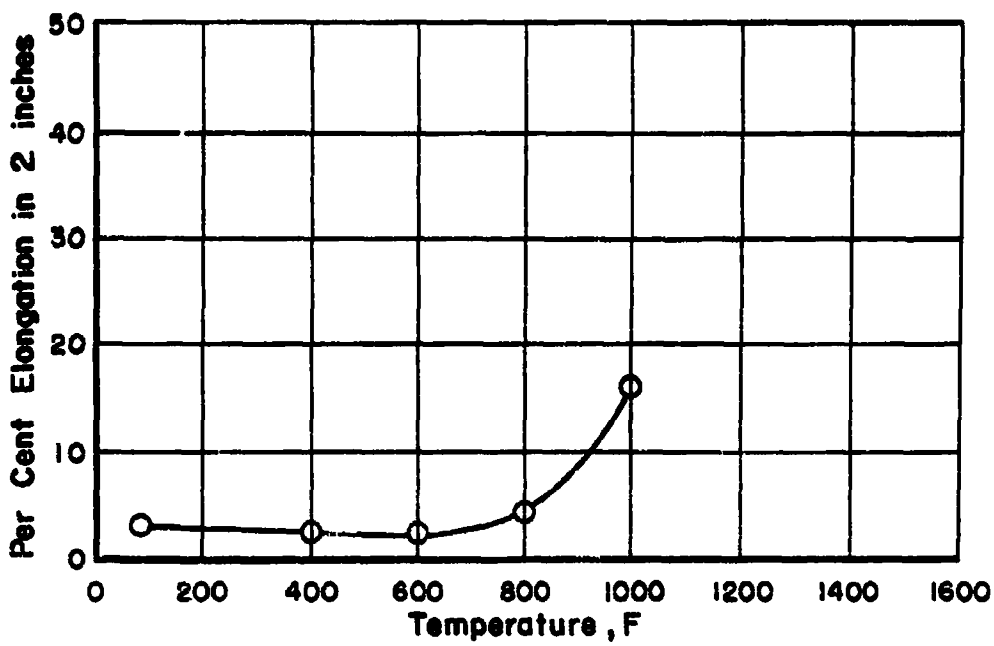


FIGURE 326. EFFECT OF TEMPERATURE ON ELONGATION OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

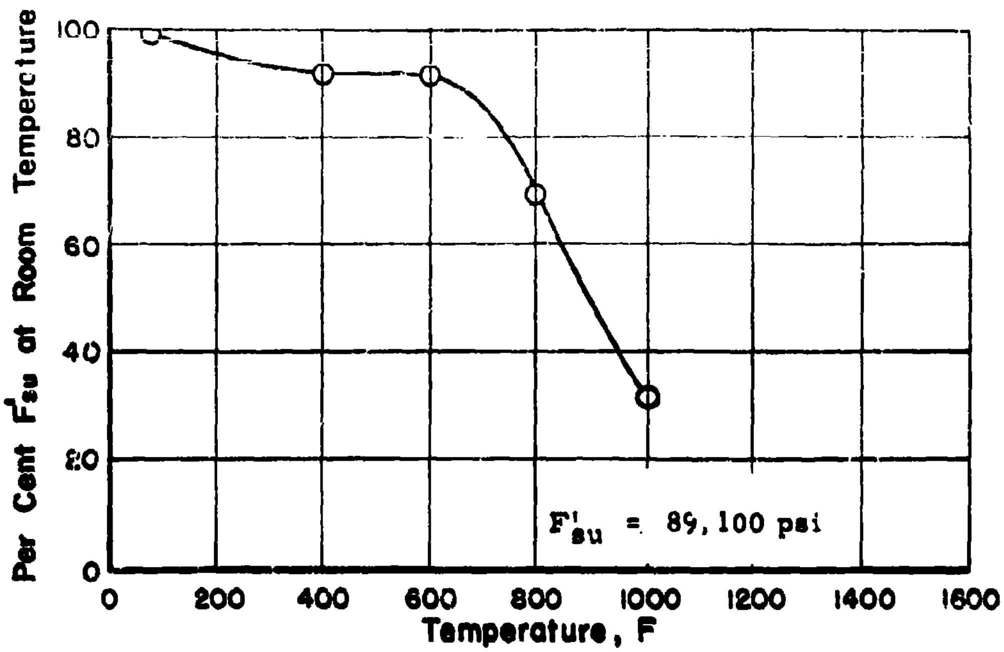


FIGURE 327. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

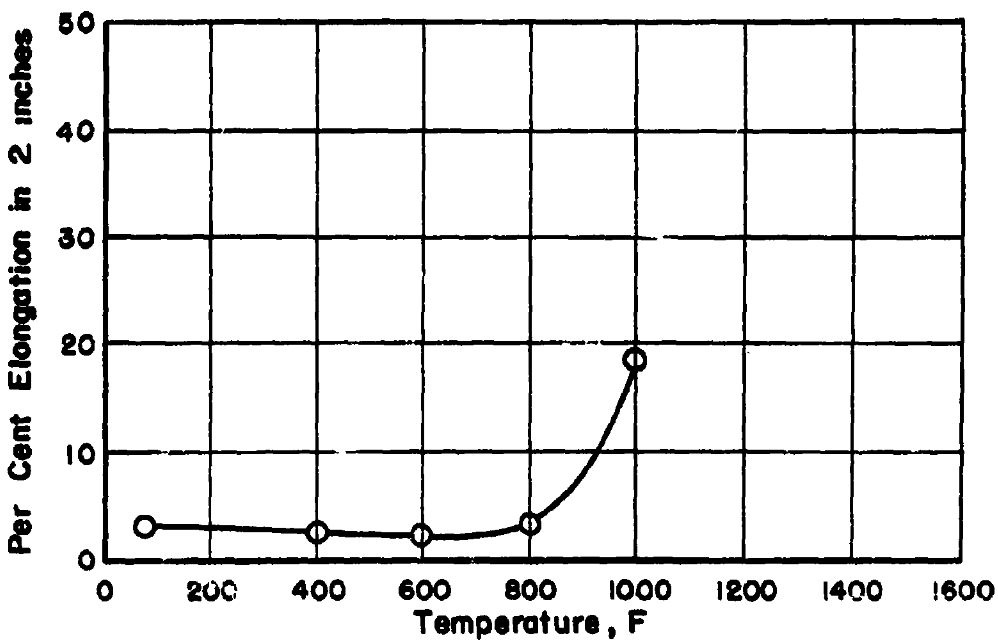


FIGURE 328. EFFECT OF TEMPERATURE ON ELONGATION OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

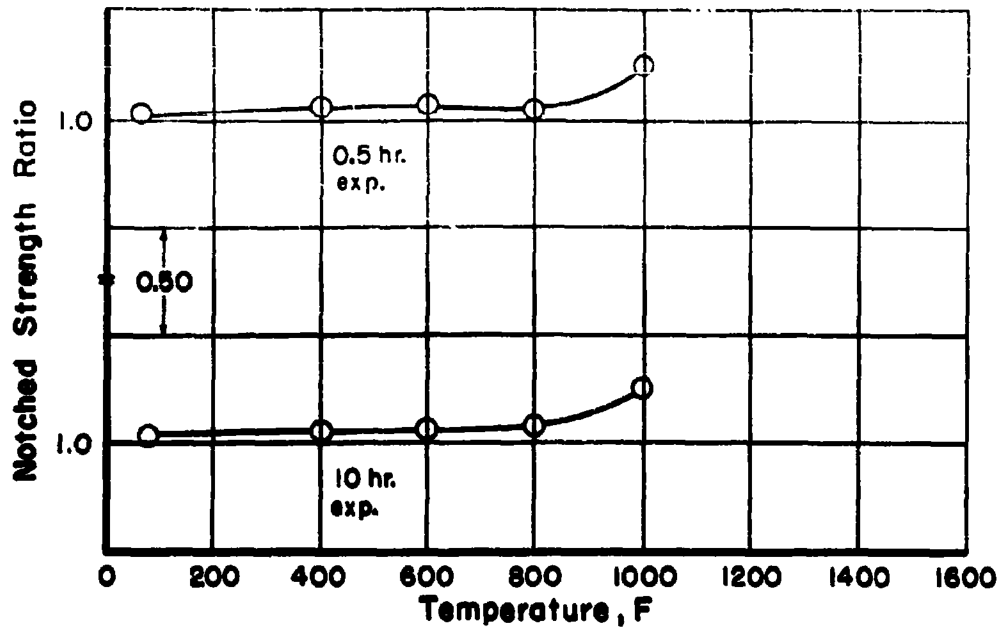


FIGURE 329. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 AND 10 HOURS

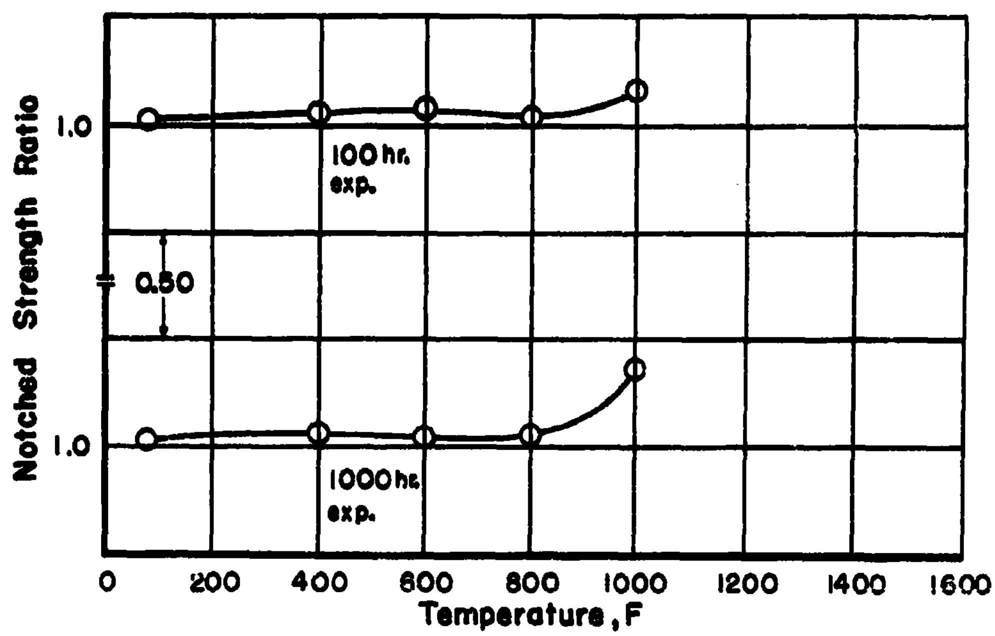


FIGURE 330. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 AND 1000 HOURS

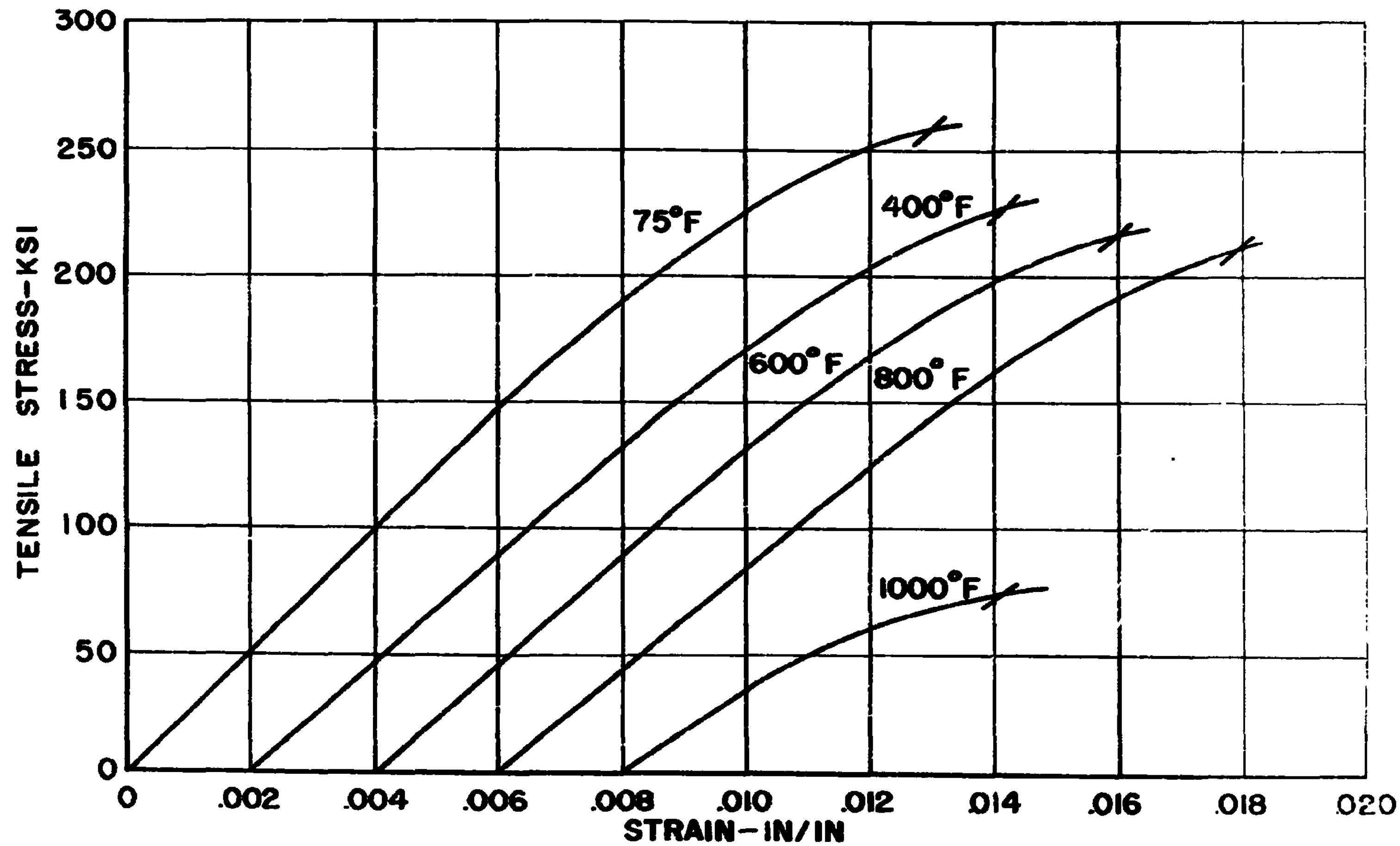


FIGURE 331. TENSILE STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

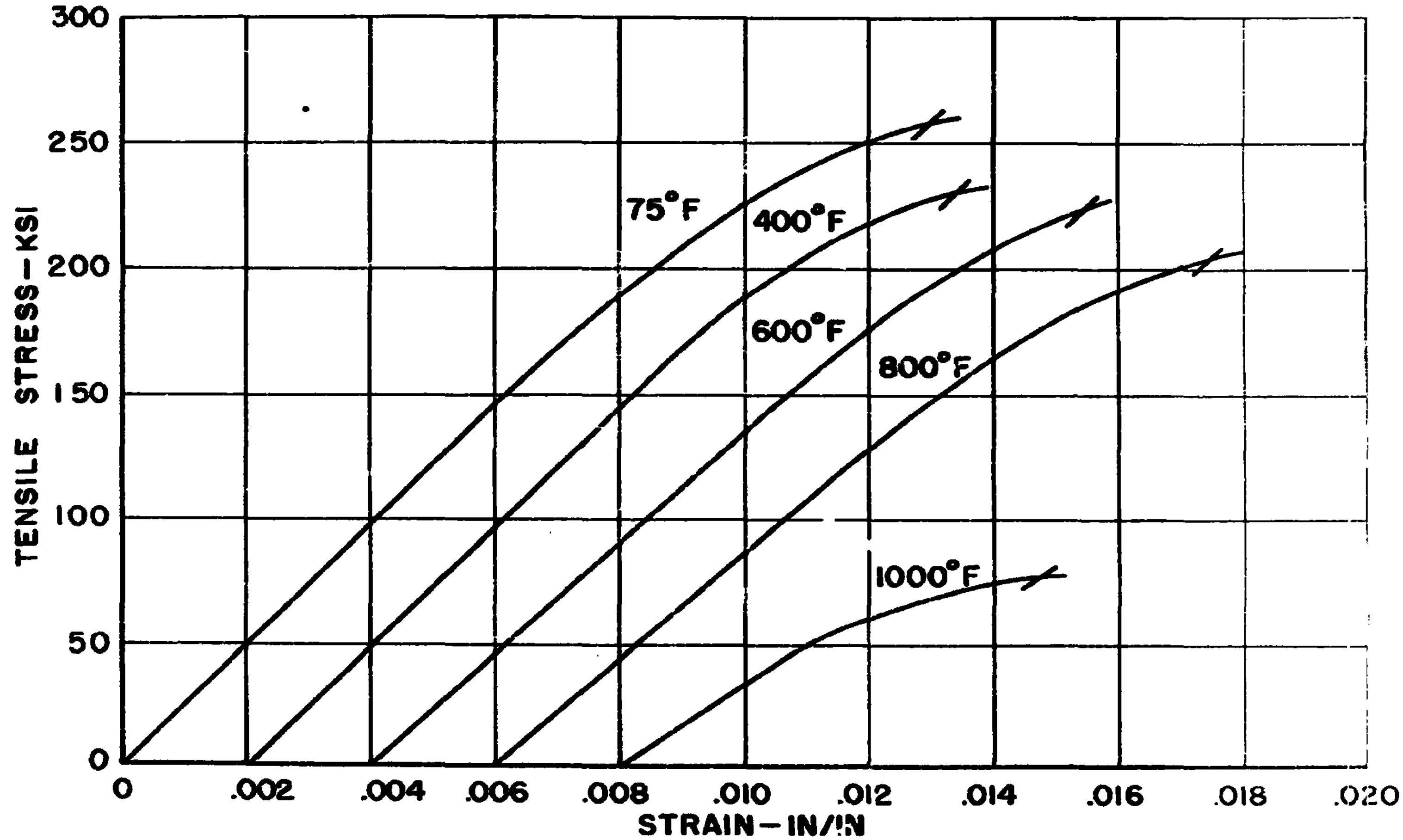


FIGURE 332. TENSILE STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

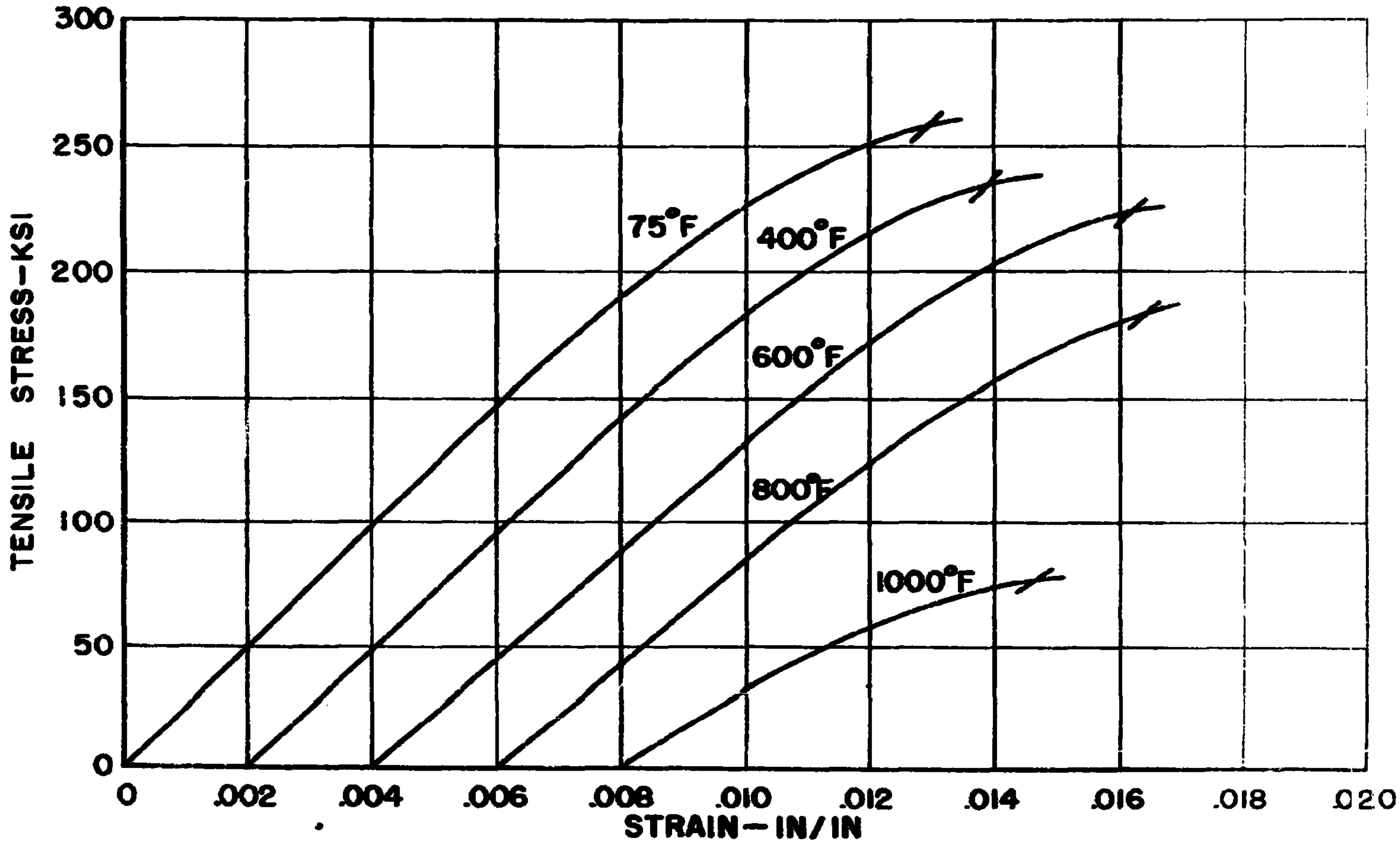


FIGURE 333. TENSILE STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

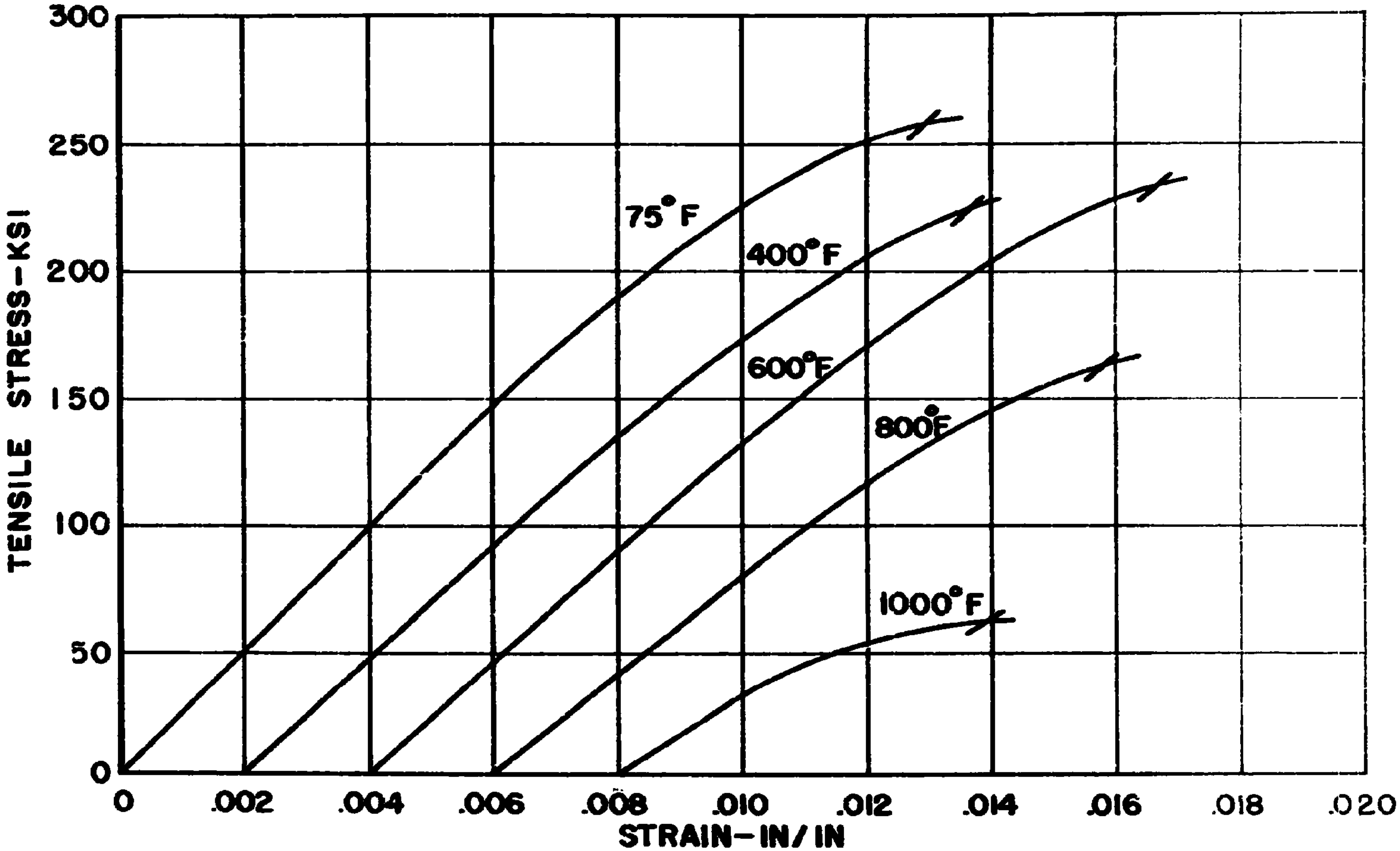


FIGURE 334. TENSILE STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

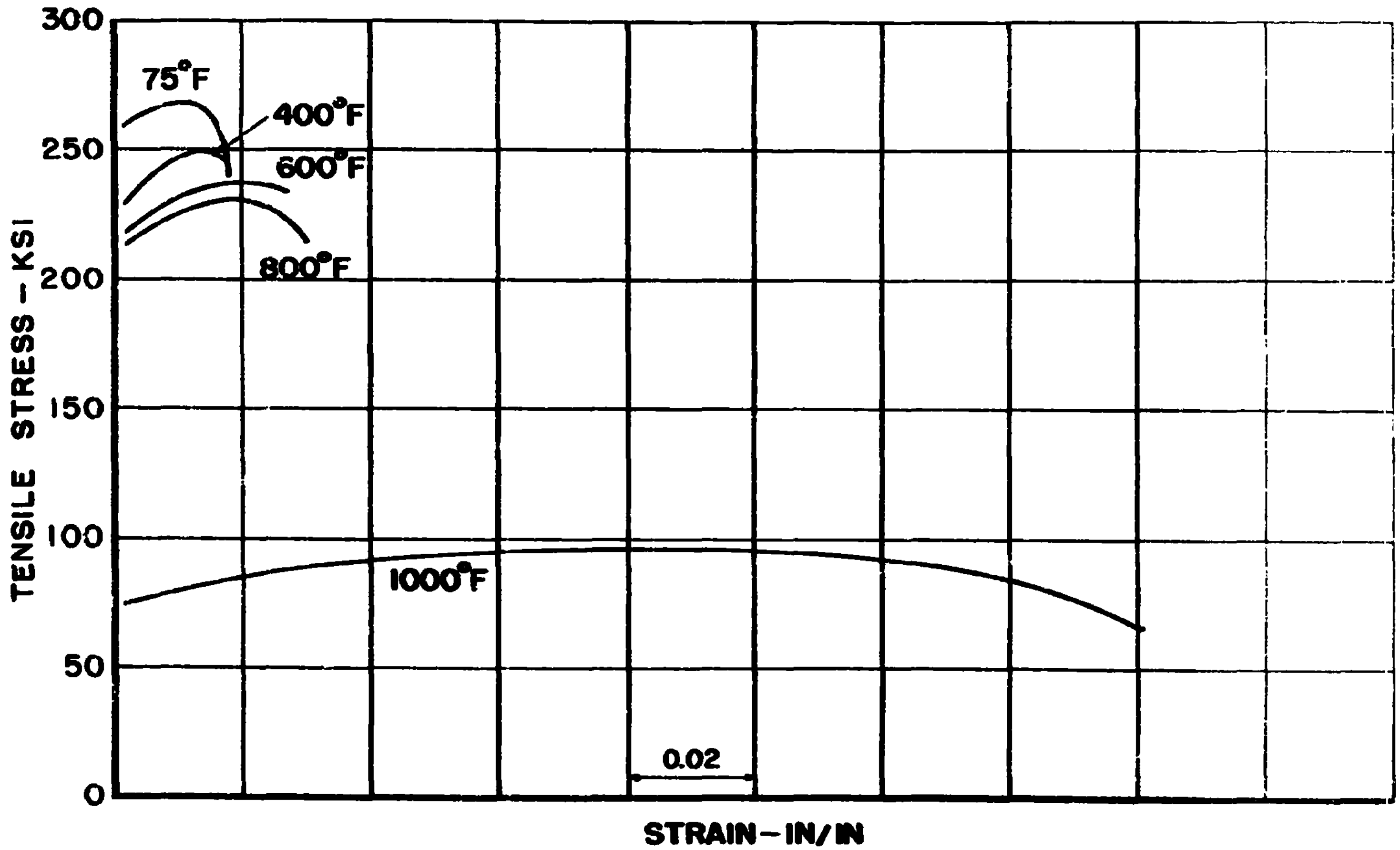


FIGURE 335. TENSILE POSTYIELD STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

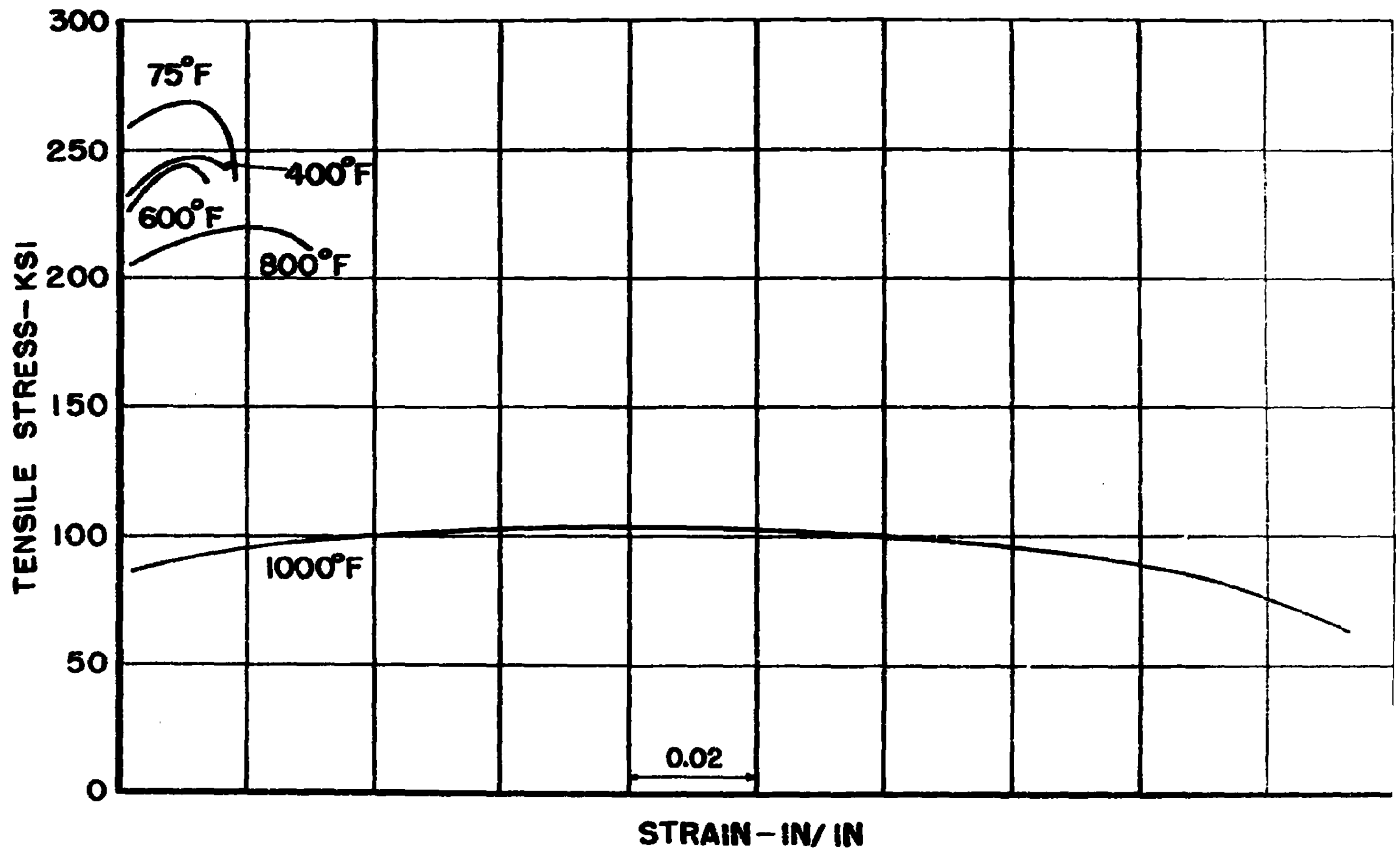


FIGURE 336. TENSILE POSTYIELD STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

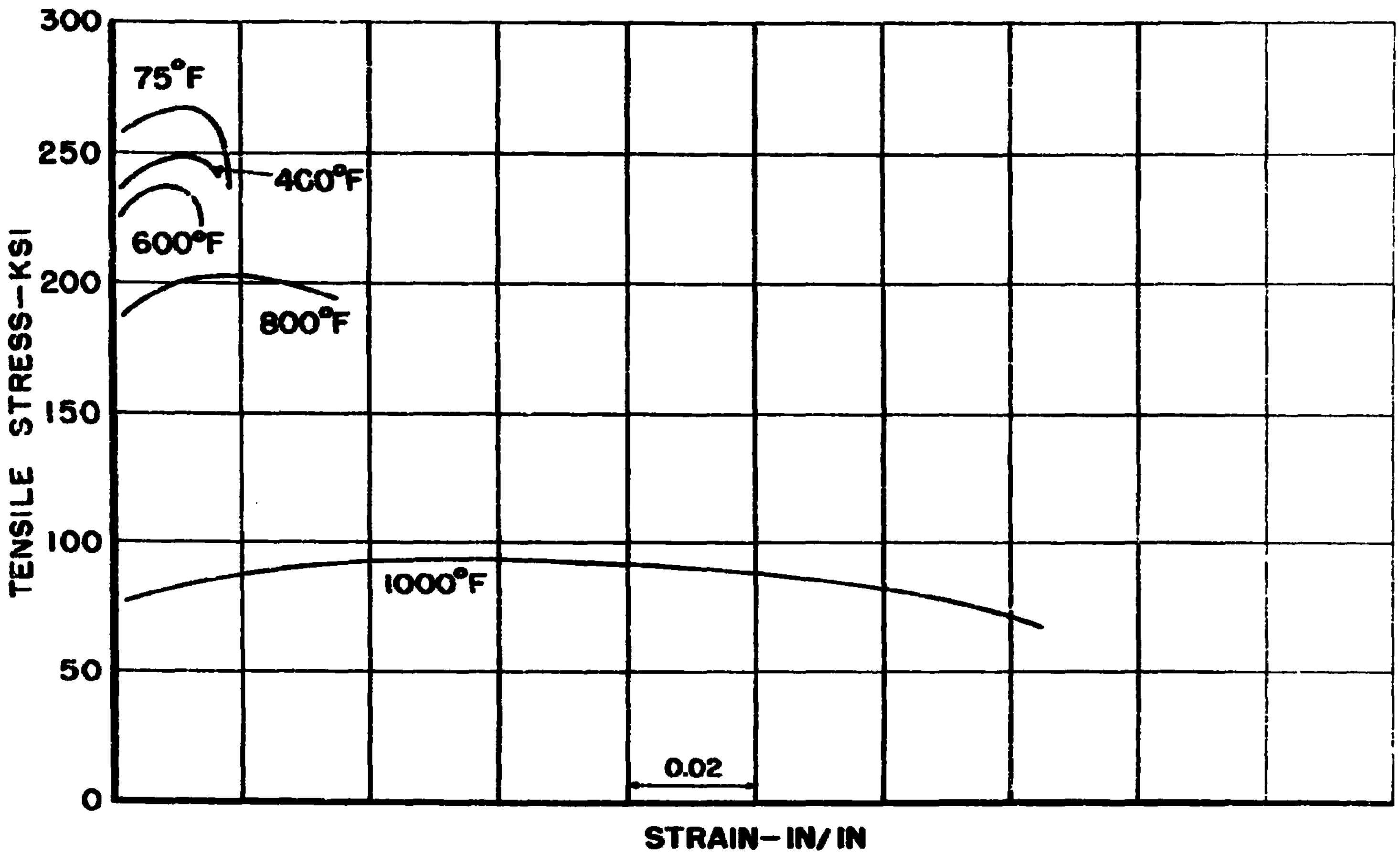


FIGURE 337. TENSILE POSTYIELD STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

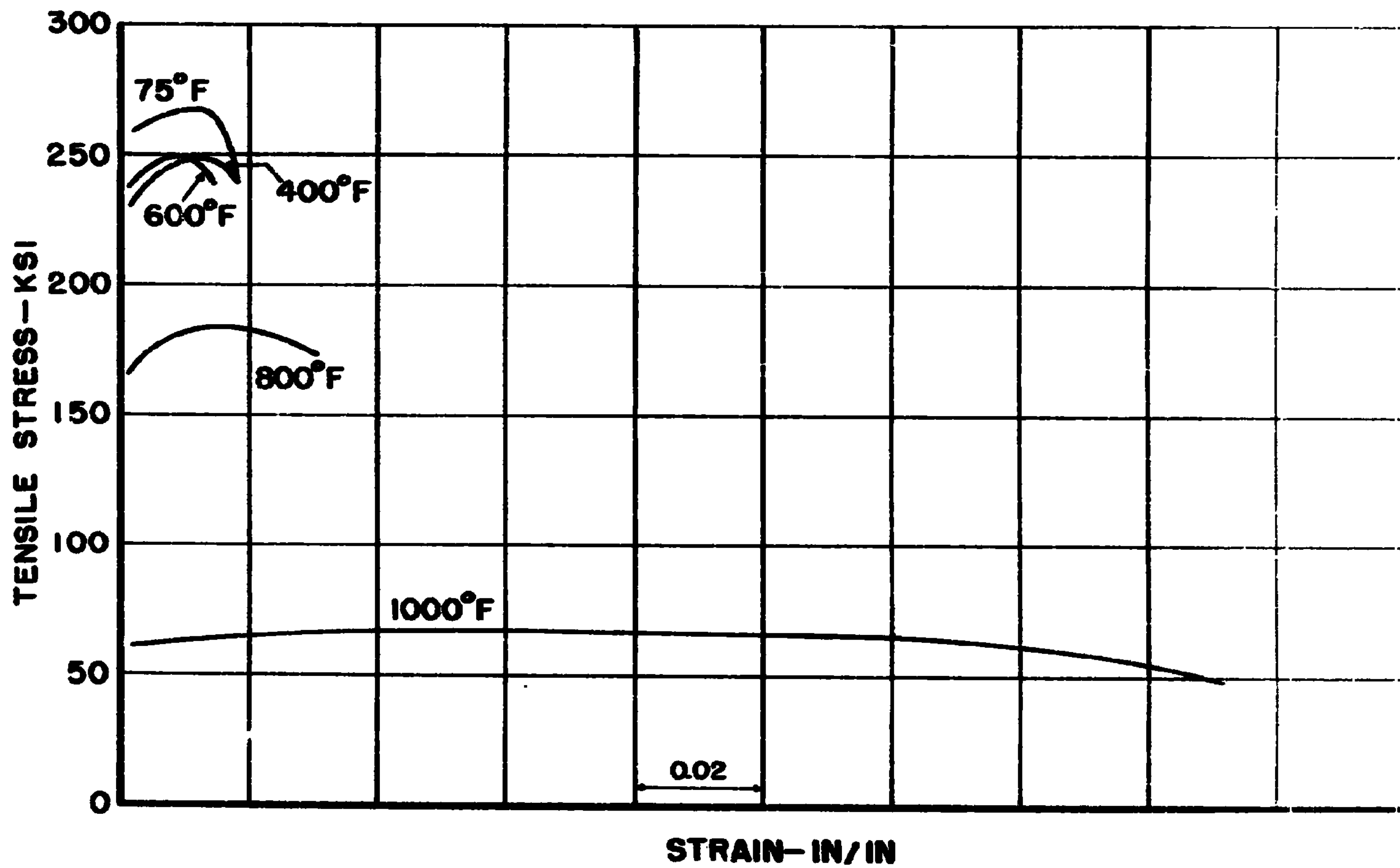


FIGURE 338. TENSILE POSTYIELD STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

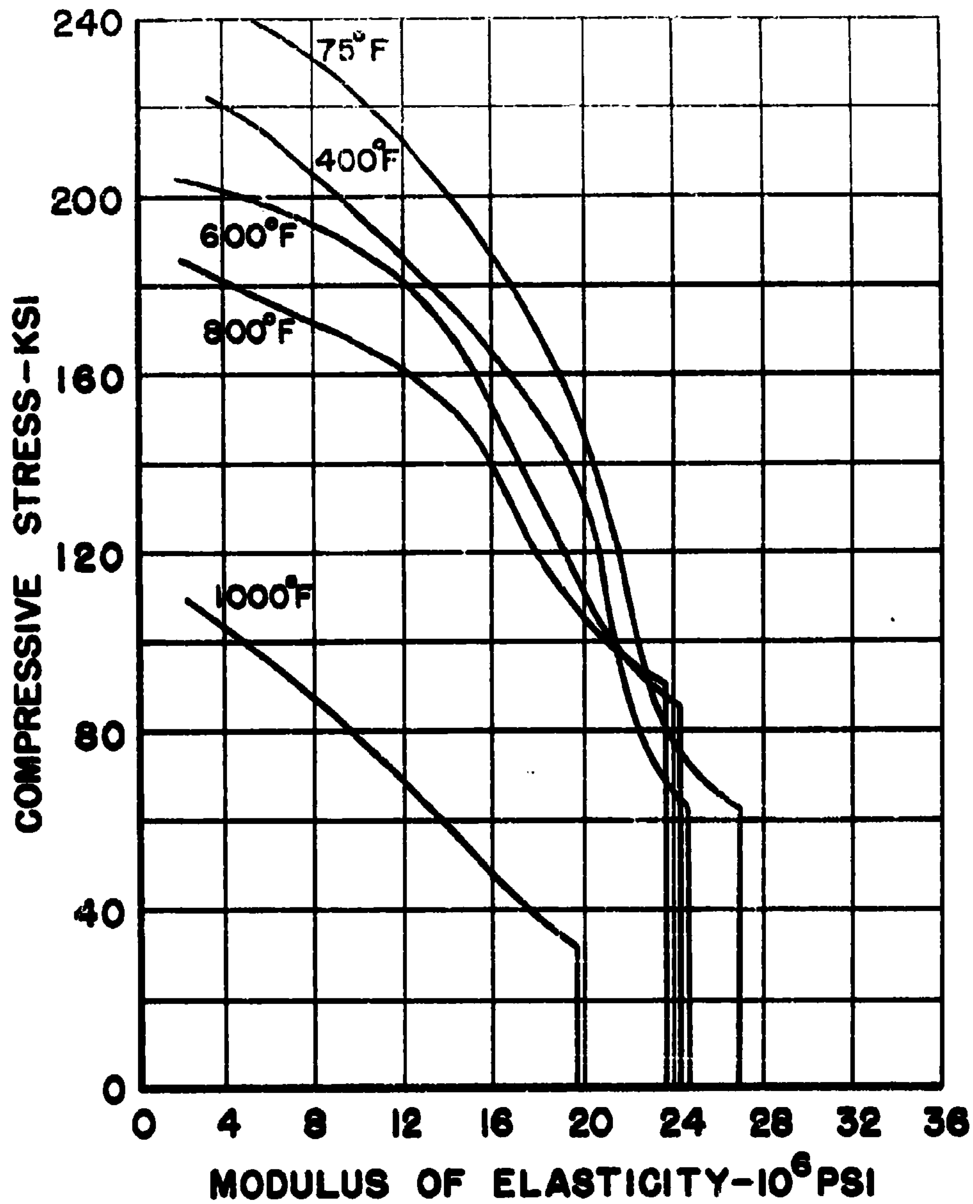


FIGURE 339. COMPRESSIVE TANGENT MODULUS CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

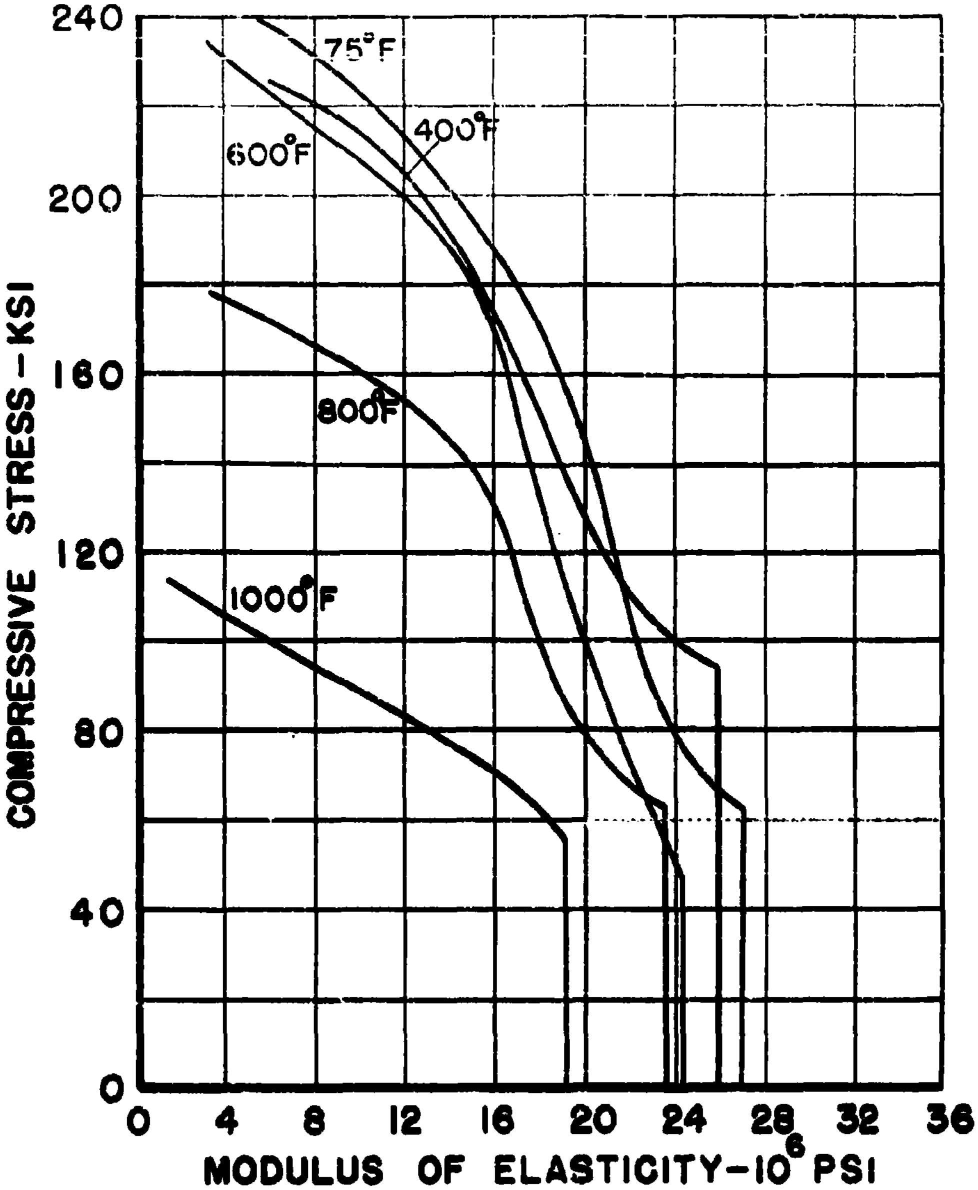


FIGURE 340. COMPRESSIVE TANGENT MODULUS CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

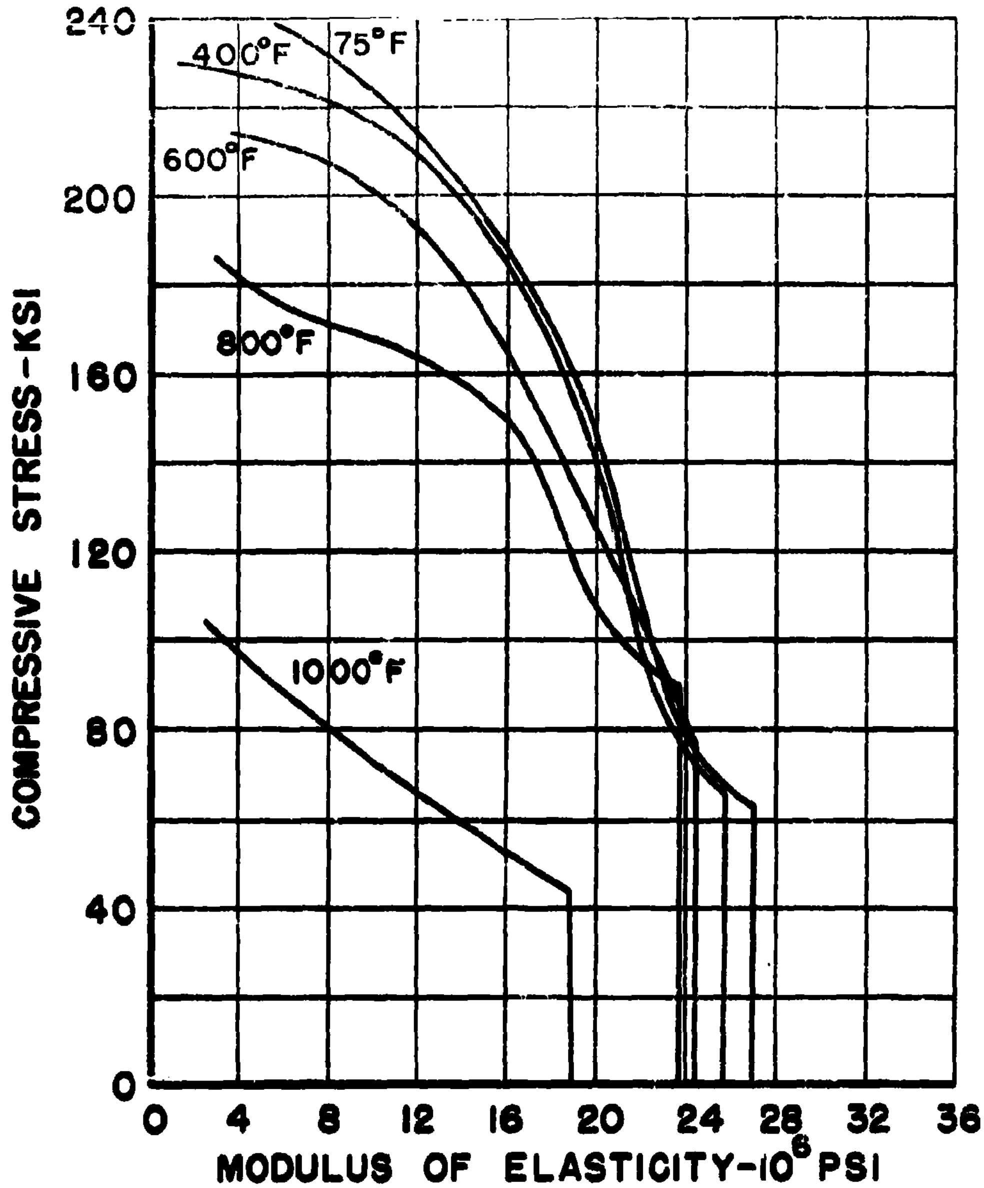


FIGURE 341. COMPRESSIVE TANGENT MODULUS CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

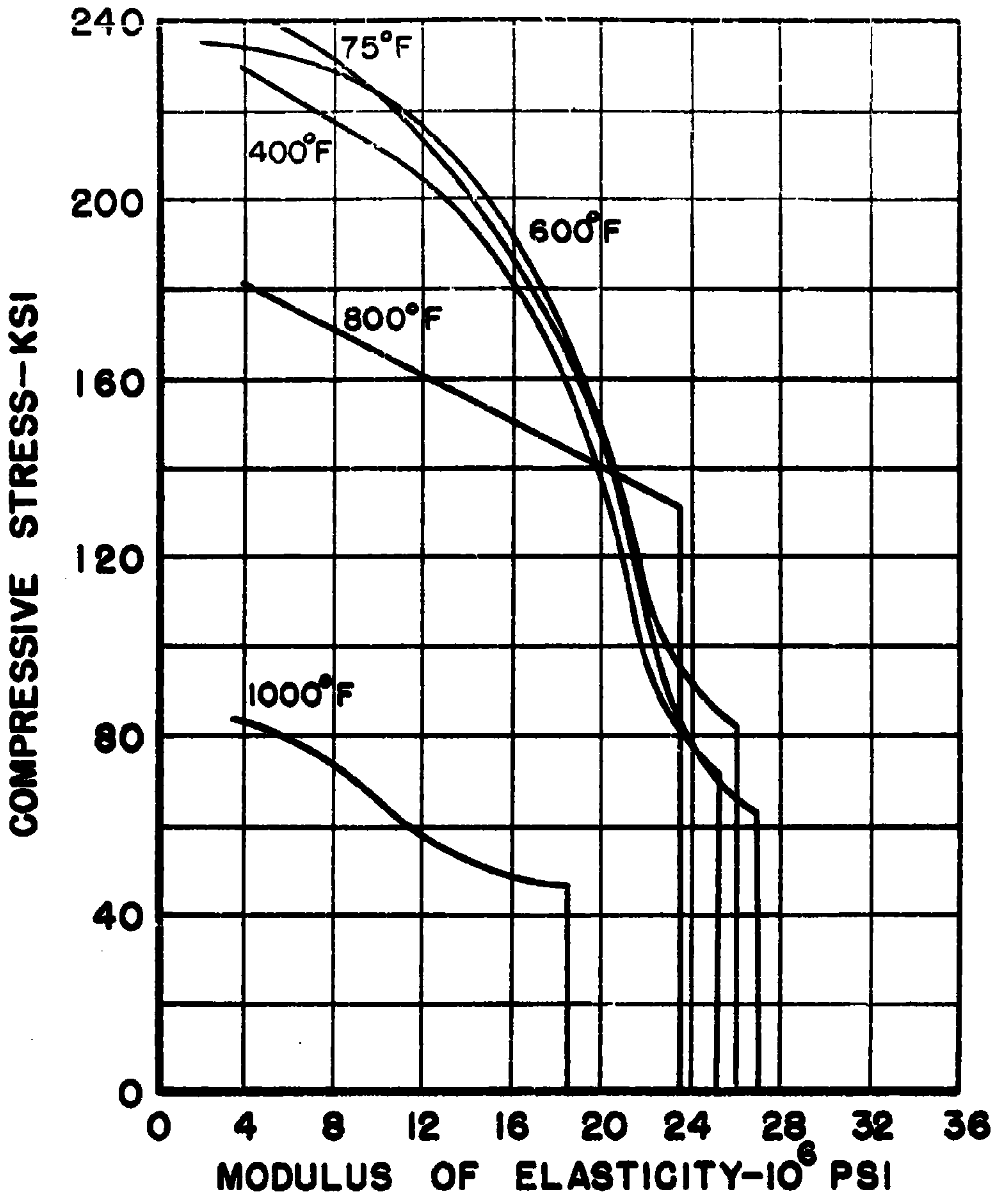


FIGURE 342. COMPRESSIVE TANGENT MODULUS CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

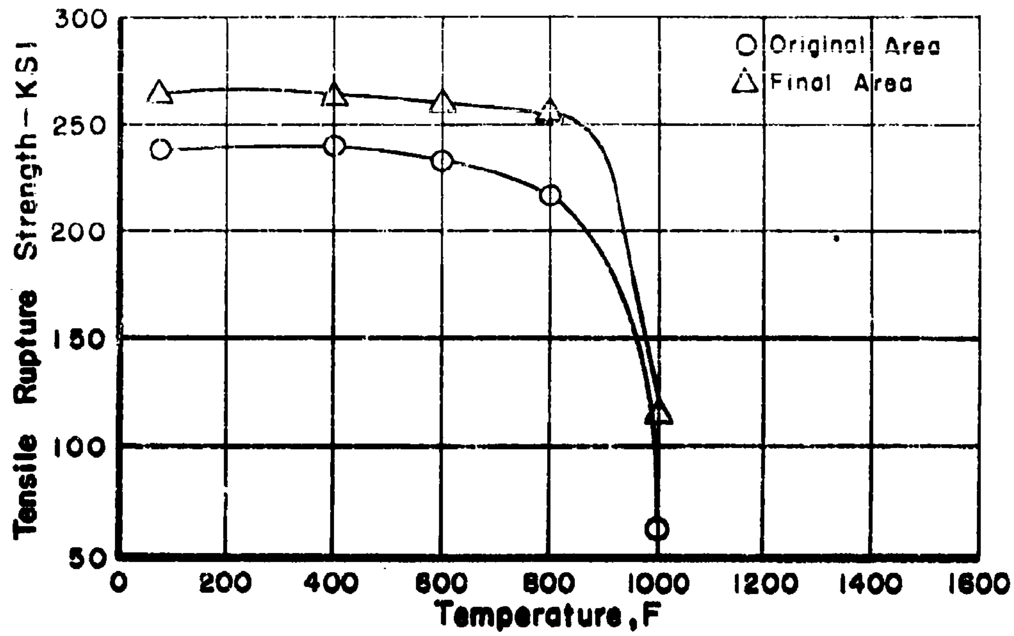


FIGURE 343. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

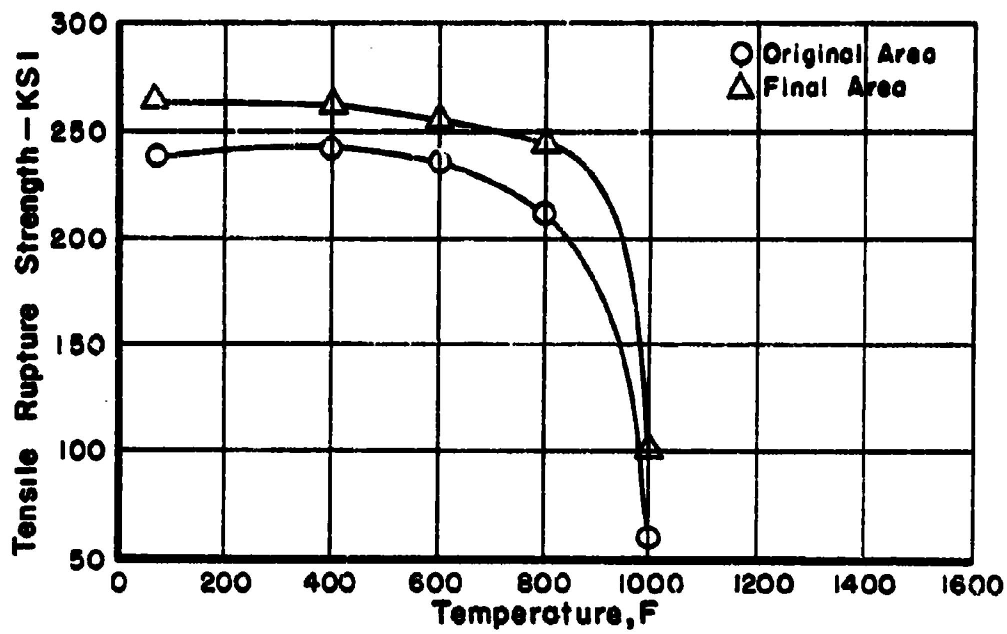


FIGURE 344. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS, BASED ON ORIGINAL AND FINAL AREAS

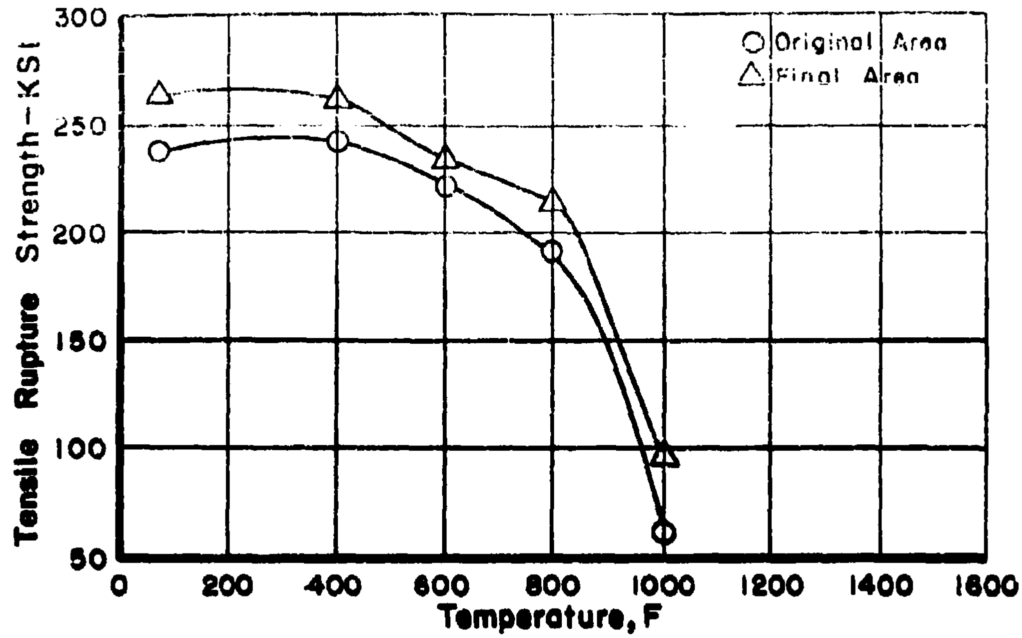


FIGURE 345. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

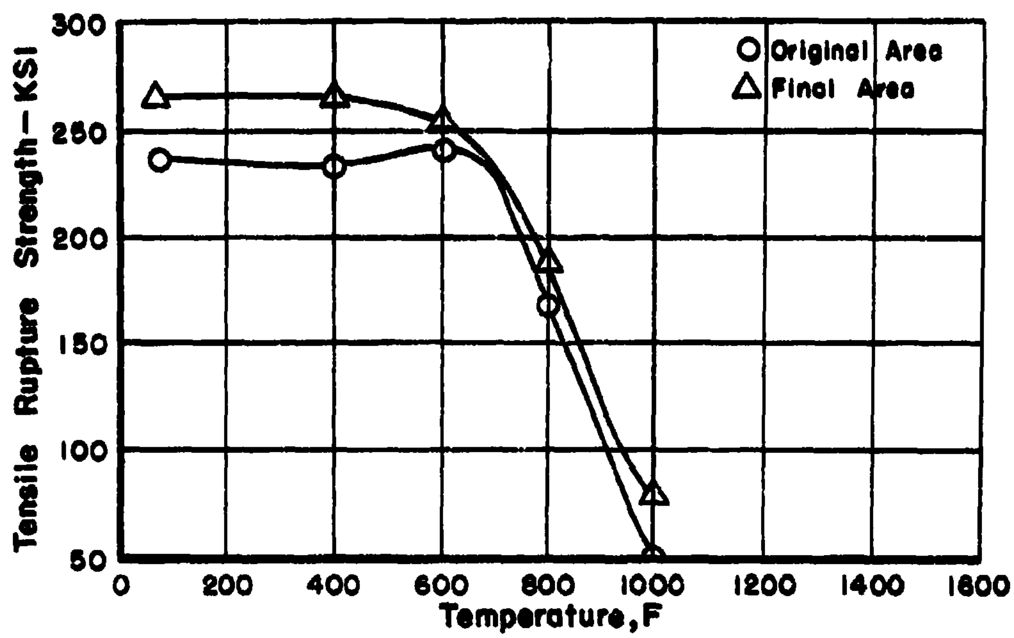


FIGURE 346. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

Aeronautical Systems Division, Dir/Materials and Processes, Metals and Ceramics Lab, Wright-Patterson AFB, Ohio.
Rpt Nr ASD-TDR-61-529. DETERMINATION OF THE EFFECTS OF ELEVATED TEMPERATURE MATERIALS PROPERTIES OF SEVERAL HIGH TEMPERATURE ALLOYS. Final report, June 62, 398p. incl illus., tables.

Unclassified Report

This investigation was conducted to determine mechanical properties of several high performance alloys at room and elevated temperatures. The effects of temperature (up to 1900°F) and exposure (up to 1000 hours) at temperature on the tensile, compressive, bearing and shear properties were determined from measured stress-strain information in both the elastic and plastic range. The following five materials were considered in the program:

( over )

1. 301 extra hard stainless steel
2. Ph15-7Mo (TH 1050)
3. AM 355
4. René 41
5. N-155

All material was from 0.050-inch sheet, except the material for the 1/8-inch diameter shear pins, which were fabricated from 1/4-inch plate. Heat treatment was in accordance with existing specifications for the materials, or other procedures approved by ASD to develop the optimum strength properties.

Descriptions of the test specimens, equipment, and procedures used are included. Test results are reported in tables and in curves showing the effects of temperature and time on the various mechanical properties.

1. High temperature Alloys
2. Mechanical properties
I. AFSC Project 7381, Task 738103
II. Contract AF 33(616)-7056
III. Southwest Research Institute, San Antonio, Texas
IV. M. M. Lemcoe, A. Treviño, Jr.
V. Aval fr OTS
VI. In ASTIA collection

Aeronautical Systems Division, Dir/Materials and Processes, Metals and Ceramics Lab, Wright-Patterson AFB, Ohio.
Rpt Nr ASD-TDR-61-529. DETERMINATION OF THE EFFECTS OF ELEVATED TEMPERATURE MATERIALS PROPERTIES OF SEVERAL HIGH TEMPERATURE ALLOYS. Final report, June 62, 398p. incl illus., tables.

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